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MONOGRAPH

OF THE

BRITISH APHIDES.

VOL. III.

BY

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“*Servare modum, finemque tenere, naturam sequi.*”—*Lucan.*

“To keep a mean, to hold the end,
And Nature’s conduct to attend.”
Quoted by Montaigne.

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P R E F A C E.

THE illustrations of this and former volumes require a few words of comment. There are high authorities who may demur to the departure I have made from precedent as to the posing of my figures. It has been said that many fine plates of animals and plants have been rendered useless to science by the artistic rendering of a graceful attitude or an elegant curve—that the figure for science, again, should be representative or, to a certain extent, abstract. Biological illustrations certainly are not meant to please the eye alone. Yet no gain can be had by mere naked unclothed facts in drawing, and if all art is to be eliminated from science many will turn with disgust from that which by a better treatment would please. The natural pose of a bird or reptile can always be connected by an efficient artist with such scientific details as are capable of being rendered in the external form. Where the camera is employed this posing is inseparable from the representation of living insects; and after all, notwithstanding that the views are necessarily perspective, measurements may be made from them as reliably as from ordinary eye drawings.

It remains for me cordially to thank numerous friends for liberally helping me with specimens for description. Where I have omitted to do this in the text, I wish here to express my obligations to them.

WEYCOMBE, HASLEMERE ;

December, 1880

BRITISH APHIDES.

INTRODUCTION.

It is a necessary condition of all Monographs that they should be classificatory. This department of biological science is a connecting link between the work of the anatomist and the theorist, for the labours of both would be wholly nugatory if identification of organisms and their relations to each other were ignored. The systematist is therefore an important contributor to the advance of all science.

The construction of a true natural classification requires mental attainments of a high order, and involves an acquaintance with extensive groups of living forms. Thus, comparatively few have possessed the requisite powers of comparison, aptitude to see correct lines of affinity, and acuteness to eliminate characters which, perhaps, showy and obvious in themselves, are nevertheless of minor importance. Thus, the conception of a race, a tribe, or genus, must partake more or less of an abstract thought, and no two minds, perhaps, will think alike in all particulars.

In more than one instance I have in this Monograph been induced, somewhat against my wish, to propose a new genus upon the evidence of a single species. Mr. Bentham has warned us of the suspicion which naturally attaches to such a procedure. Still, if we concede that nature is not bound by our conceptions of typical forms, they may be permitted for systematic

purposes ; otherwise to our minds order would revert to chaos.

Much has yet to be done in comparing and collecting Aphides from other countries, so that there is a probability that species will yet be discovered to enrich genera, as yet but poorly represented. The science of embryology is daily contributing to a sound phylogeny, which really lies at the root of all natural systems.

The Aphididæ seem to extend over all the regions of the Northern Hemisphere, extending from the extreme west of Asia, throughout Europe, and across the entire continent of North America. Species have been taken, but not as yet identified, on the slopes of the Himalaya, and probably it only wants attention to show that they obtain also in the temperate regions of Africa.

The great problem of the day, and likely to be for many years hence, is the possible development of higher out of lower forms. Kant says "Geologists are archæologists of nature, and the sole irrefragable and direct evidence of the method by which living things have been what they are is to be sought amongst fossil remains."

The great difficulty that the Entomologist feels in an appeal to the rocks for evidence, is the comparative scantiness of specimens hitherto brought to observation, and the bare indications yielded as to the sequence of insect orders in the world's history. The fragility of the bodies of many insects is doubtless one cause of this imperfection of the record ; but, as the ancient Devonian beds give unmistakable indications of their occurrence, this branch of the animal kingdom must have come into existence at a very early stage of time.

The rise of insect life on our globe has been well treated by several competent writers. The attempt to introduce so large a subject into this Monograph would be quite out of place, but briefly it may be noted that an examination of the most ancient fossils yet discovered, shows that insects, even at the above

early date, were highly specialised. The elaborate veining of the wing of *Xenoneura antiquorum*, which apparently points to a family combining characters of a chirping cricket (*Orthoptera*) and a water-fly (*Ephemera*), leads to the probability that far more simple forms preceded such, about which there is now no record.

As might have been expected, the Coleoptera are the most fully represented in a fossil state; their dense elytra and their hard exteriors are less open to disintegration than the softer bodies of the Hemiptera and Lepidoptera. The Hemiptera would appear to be not much less ancient than the Orthoptera, for they have been found in the Carboniferous beds of Great Britain and America. Singular unions of type again show themselves in certain examples from the Permian strata; such having in their mouth parts, compounded characters of the mandible and haustellum. Both the Orthopterous and Hemipterous orders are represented in the genus *Eugeria*.

Most of the strata in an ascending series from the Devonian, show more or less an abundance of insect remains, but perhaps the Liassic and Oolitic formations are most remarkable for the number of species.*

The occurrence of the Hemiptera-Homoptera in a fossil state is much less frequent than that of the Hemiptera-Heteroptera. According to some we find their first appearance as the interesting *Palaeontina oolitica*, which occurs in the Stonesfield roofing-stone.

But whether or not this form has been rightly classified, the Homoptera are clearly represented in the insect limestones of Wiltshire and Dorsetshire. In the Purbeck beds of these counties even the small and frail bodies of the Aphididæ have left their impressions on the soft mud. These are accompanied by the allied Homopterous families of the Cicadidæ and

* Prof. Oswald Heer, 'Die Urwelt der Schweiz.,' 1865. Translated by W. S. Dallas, 1876.

Cercopidæ.* Aphis, therefore, here for the first time asserts its claims to the antiquity of its race.

Our present geological evidence will, therefore, lead us to place the Hemiptera fourth in the order of birth in primæval time, and thus to place the Diptera, the Hymenoptera, and the Lepidoptera last on the list. This sequence might, indeed, have been partly inferred, if we take into account the connection shown by our modern existent orders with phanerogamous plants.

The following may be assumed as the order in which insects appeared, as set forth by known fossil remains.

1. Neuroptera.	Devonian beds.
2. Orthoptera.	Coal-measures.
3. Coleoptera.	Carboniferous series.
4. Hemiptera.	
,, Heteroptera.	Permian and Lias.
,, Homoptera.	Lower Oolite and Purbeck. Aphis.
5. Diptera.	Upper Oolite, Solen- hofen limestone.
6. Hymenoptera.	Solenhofen. Apis.
7. Lepidoptera.	Solenhofen ? Sphinx.

Koch has described several fossil genera allied to the minute *Thysanura*, which have been preserved. Such being the case, we may not think it hopeless that yet more evidence will turn up of the occurrence of Aphides in ages long past, where climatal and other conditions permitted.

The number of described living insects, Mr. Bentham tells us, exceeds that of all known plants. Some ten years ago Gerstaecker stated that the former exceeded one hundred and sixty thousand. Mainly through the pregnant hypothesis of Mr. Darwin, a considerable stride has been made, as to deduction and correlation, from materials supplied by these descriptions; so that now Entomologists less acutely may feel the charge

* *Vide* a compendious treatise by Mr. Herbert Goss on the 'Geological Antiquity of Insects.' Van Voorst, 1880.

made against them some years ago, that their “ science failed much in giving the origin, progress, migration, mutual relation, struggle, decay, and final extinction of species.”

Still, when we step out from the observation of fact into the region of speculation, we must feel less certain of our footing. Many difficulties beset us as soon as we leave the “irrefragable direct geological evidence.” If we ask what has been the order of insect evolution, and the channel through which one form rose from another, the answer is obscure.

In his Monograph of the Collembola and Thysanura, Sir John Lubbock places before the reader in a succinct form, considerations as to the probable parent stock of Insecta, and he there so discusses the views of Fritz Müller, Haeckel, Brauer, and Darwin, that it will be right to touch but lightly upon it here.

Some have felt considerable difficulty in conceiving evolutionary passages from the powerful gnawing jaws of the Orthoptera or Coleoptera, into the weak suctorial organs of the Hemiptera or Lepidoptera. In the last family it will be remembered that the larvæ are mandibulate, and the imagos are hanstellate.

By adoption of *Campodea* (Thysanura) as an ancestral form, in which representative parts of jaws and proboscis are present in the same insect, Sir J. Lubbock thought much of this difficulty vanished.

Fritz Müller elects the wingless Orthoptera, or *Blattidæ*, amongst existing insects, as most nearly approaching to the ancient form; and further, he thinks that the metamorphosis of the Coleoptera and Lepidoptera was of later origin. The imperfect metamorphosis of the first insects, he thinks, is more like a picture of an original mode of development than the perfect metamorphosis of beetles or moths. As to the probability of greater age in such an incomplete metamorphosis, Sir J. Lubbock quite agrees.

Haeckel thought that the four mandibulate orders preceded the four sucking orders in time, but that an

insect something like *Libellula* was the type of the original stock.

Sir J. Lubbock suggested, as a part solution of these difficulties, that there is a distinction between developmental and adaptive changes. Metamorphic variations, indeed, do not necessarily proceed from the simple to the complex, like ordinary growth of tissue; but organs increase or become atrophied, according to the wants of the insects attending their conversion into pupæ or imagoes.

There can be little doubt that insects undergo minute modification of form and organs throughout their entire existence, if we except, perhaps, the quiescent periods of chrysalis life. The action of temperature, food, climate, starvation, or satiety, reacts on the organism more completely perhaps, whilst the animal is young, but developmental changes are induced at each moult of skin; and beyond and intermediate to these stated periods, modified growth and change of form are effected. Thus, in the moultings of Lepidoptera, something more is accomplished than the formation of a larger skin for the insect. Important changes take place, which are interestingly shown by the casting of the internal mucous membranes of the tracheæ.

The fact is significant that some beetles, like *Meloæ*, are born hexapod, and afterwards become apterous maggots in the cells of bees, an economy discovered some years ago by Newport. This has been considered by some as a proof that the caterpillar form is adaptional and not strictly developmental.

Whilst in the embryo of the Crustacean the limbs come into view before the segmentation, in Insecta the segments precede the formation of the legs. Fritz Müller, and Packard also, thought it probable that perfect insects appeared before larvæ or pupæ, and that the vermiform type is more recent. They considered the primitive form was nearly allied to our grasshoppers (Orthoptera). Relative to this observa-

tion, N. Wagner points out that the vermiform larvae of certain small gnats have reproductive power to carry on the series. In Diptera the larvæ are footless grubs.

With reference to the mandibulate and haustellate types of mouth, Sir J. Lubbock says "In *Campodea* a type of animal occurs closely resembling certain larvæ which occur both in the mandibulate and suctorial series of insects." On this account it is urged that many difficulties would vanish by an adoption of *Campodea* (*Thysanura*) as an ancestral type of *Insecta*.*

Conformity to conditions and occasional reverersions to ancestral types are now generally accepted biological facts, and by their consideration we may expect a good intellectual harvest. In the present volume some remarkable examples of degradation are shown—cases in which the visual organs are entirely aborted,† others where they are in process of development during metamorphoses of the insect, and only show their completeness in the imago. Similarly, the mouth-organs are found to be aborted in the sexes of other species. Once more we may find indications of a possible reversion to an earlier type in some simpler forms of an early age.

We may ask, Is the slightly endowed subterranean *Aphis* more nearly allied to some presumed ancestral form, but little differentiated; or should we consider it to be a degradation from some higher genus like *Siphonophora* or *Drepanosiphon*? If we argue that old forms are foreshadowed in embryology, the *Aphididæ* should come from a far-seeing stock; for eyes appear in very early stages within the egg.

Thus, in *Trama* shall we trace, according to the suggestions of Professors Lankester and Balfour, the acquisition of eyes from a local deposit of pigment, which through the stimulus of light and heat raises the

* 'Monograph of the Collembola,' Ray Society, 1873, p. 52.

† Examples of Aphides without eyes may be found in *Trama*, Pl. CII, fig. 6; in *Schizoneura*, Pl. CVI, figs. 4—9; *Pemphigus*, Pl. CX, figs. 3—8; Pl. CXI, fig. 8; Pl. CXII, fig. 7. In other underground larvæ the eyes, if present, are very small.

outer cuticle into a crystalline lens, with the subsequent ganglionic elaboration of a retina, with its attendant nerves, &c., and throw all modification of form on the adjacent surroundings?*

A similar question arises, whether the tendency in *Aphis* to show supplementary wing-veins is a sign of development or the contrary.† Activity and swiftness in flight are not necessarily connected with breadth of wing. The nervous energy of the higher Hymenoptera gives strength to their flying organs, which, though relatively small, are capable of much locomotive power.

Again, shall we say that the lower Aphides are degradations from *Psylla*, or improvements upon *Coccus*?

Probably Sir J. Lubbock would hesitate to regard the Apterous *Aphis* as a larva, in the ordinary sense; and therefore its inactive form will not bring exception to his supposition, that larvæ which live in circumstances which call for no locomotion, have relapsed into the condition of their far distant vermiform ancestors.‡

In introducing these remarks upon these hypotheses, we accept the conclusions simply as instalments, and valuable contributions towards an abstruse and difficult question.

If “Phantasie” or theory be an element in the demonstration of true science, she must ever be a handmaid, but never a mistress. Some thinkers, like Professors Tyndall and Lankester, have boldly acknowledged that philosophers are, and ought to be, largely occupied with speculation and imagination. The

* Examples in which the transparent corneal membrane is shown to be an expansion of the ectoderm or external cuticle may be seen in Pl. B, fig. 2; Pl. XVII, fig. 4; Pl. XXI, fig. 4; Pl. XXII, figs. 4 and 5. Some of these drawings show, also, how the optic nerve is in communication with the œsophageal ganglion.

† The excess or defect in the veining of the cubitus may be seen in Pl. XXXV, fig. 3; Pl. LVII, fig. 2; Pl. LXVI, fig. 2; and Pl. XCVI, fig. 5.

‡ A slight tendency to the vermiform type, perhaps, may be traced in the young underground inert larva of *Pemphigus*, see Pl. CXII, fig. 11.

latter, indeed, has asserted that “biology is not the less exact, our conclusions are no less accurate, because they are only *probably* true.”

However this may be, science which investigates causation must to us be based upon likelihood; and therefore, so far, it partakes of a compromise. The intelligent grouping of facts in one series, is uniformly attended by another smaller series, which will not lend themselves to the conception of the law deducible from the first grouping. But no one will loyally put aside that law, if it be reasonable, on account of exceptions to it; but receive it as an instalment and vantage-ground gained from the land of ignorance.

If a master-mind rises afterwards and regroups these facts under another law, so as to eliminate more exceptions, the student who would ascertain the causes of things, will give in his adherence to the new line of thought, even though it be like “Phantasie.” The system of Ptolemy thus has given place to that of Copernicus; phlogiston to the atom of Dalton, which again suffers modification in the modern atomicity of Gerhardt, Graham, Wurtz, or Brodie.

After all, a knowledge of the fundamental cause of variation is the high desideratum of the biologist. How and why certain cells should have special functions of segregation for elaborating different organs we know not, and at present we see but little chance of knowing. Certain cells have been regarded as vehicles containing groups of physiological units, ready to *obey their proclivity* towards the structural arrangements of the species they belong to. This appears to accord with the views of Herbert Spencer, who assumes “units of protoplasm lower in degree than the visible cell-units of plastids, and which may be regarded as in a polar condition.”

Prof. Ray Lankester remarks that modified force-centres may become further modified in each generation, and this might be made to fit in with Mr. Darwin’s theory of Pangenesis. The subject, however, is beset

with difficulties, and we can hardly be said to have in possession materials to do more than theorise. Some inscrutable force is connected with the secret of life, with its metamorphic powers, and its attributes of irritability, assimilation, reproduction, and final death.

Mr. A. Wallace would seem desirous to cut the knot of this difficulty, by stating “that variation is an ultimate fact of nature, which wants no further explanation than that we cannot even conceive it to be otherwise.”

As motion in nature is the universal law, and even “the stars fixed for ever” have their tendency somewhere, so doubtless life and spirit are no exceptions to this rule, but have ever an upward progress, or a miserable degeneracy.

But dogmatism ill becomes the student. Montaigne quotes :

“Nec me pudet ut istos, fateri nescire, quod nesciam;”

and, again, a great mind has said :

“Doubt nestles at the root of Truth.”

“Nasce per quello a guisa de rampollo
Appie del vero il dubbio. . . .”*

“Honest doubt is the deepest spring of honest faith.”†

Nevertheless, we may yet founder upon a one-sided agnosticism—the pride which apes humility.

* Dante, ‘Del Paradiso,’ Cant. iv, l. 130.

† Prof. Max Müller, ‘Lectures in the Chapterhouse of Westminster.’

SYNOPSIS OF BRITISH APHIDIDÆ.

TRIBES.

I. <i>Aphidinæ</i>	{ Upper wing with twice-forked cubitus; under wing with two oblique veins; antennæ 7-jointed . . . } 16. <i>Callipterus</i> .
Lachninae	{ Upper wing with twice-forked cubitus; under wing with two oblique veins; antennæ 6-jointed . . . } 17. <i>Pterocallis</i> . 18. <i>Phyllaphis</i> . 19. <i>Ptychodes</i> . 20. <i>Lachnus</i> . 21. <i>Stomaphis</i> . 22. <i>Paracletus</i> . 23. <i>Trama</i> . 24. <i>Dryobius</i> .
II. <i>Schizoneurinæ</i>	{ Cubitus once forked; lower wings with 2 oblique veins . . . } 25. <i>Schizoneura</i> .
III. <i>Pemphiginæ</i>	{ Cubitus not forked; lower wings with 1 or 2 oblique veins . . . } 26. <i>Pemphigus</i> . 27. <i>Tetraneura</i> . <i>Aponeura</i> . <i>Toxoptera</i> . { Cubitus once forked; lower wing with 1 oblique vein . . . } Thelaxes.
IV. <i>Chermesinæ</i>	{ Upper wing with only 3 veins; under wing with 1 oblique vein . . . } Chermes. Phylloxera.
V. <i>Rhizobiinæ</i>	{ Winged forms unknown . . . } Tychæa. Endeis.

GENERA.

N.B. The genera in italics are not, it is believed, represented by British species.

Family—APHIDIDÆ.

Tribe—APHIDINÆ.

GENUS XVI.—CALLIPTERUS,* Koch.

ZIERLAUS. FAIRWING. GAY-LOUSE.

Rostrum stout, short ; does not reach to the second coxae.

Antennæ very long, often tipped with black ; third joint much the longest. Seventh joint variable in length, but rarely less than the sixth. In the winged females sometimes it attains to twice the length of the sixth.

Head large, vertex flat. Frontal tubercles none.

Cornicles very short.

Legs moderately long ; longest in the males.

Wings generally ample, iridescent, usually clouded with pigment at the extremities of the veins. Stigmata long. Stigmatic cells trapezoidal.

Abdomen : in some species the apterous females are hirsute. The last abdominal ring is provided with two anal valves or papillæ.

In the above description I assume that *Callipterus* possesses seven antennal joints, which some of the species ranged by Koch under his genus do not possess.

Passerini, on the other hand, restricts this genus to the two walnut-feeding Aphides, and groups it under the *Lachninae*.†

The genus *Callipterus*, as its name imports, includes some of the most elegant forms of the Aphidinæ. From their bright and lively colouring, they have

* From *καλλος*, beautiful ; *πτερον*, a wing.

† ‘Aphididæ Italicae.’ p. 66.

received the names of Zierlause in Germany, and Gaylouse in America.

The generic characters are sufficiently distinct; but nevertheless on account of the recurring difficulty, as to what constitutes a true articulation of the antenna, these insects have been variously placed, with or outside of the Lachninæ. Amongst the species named by Koch and Passerini, some have the antennal joint more than twice the length of the preceding, whilst in others it by no means equals the same. I consider, in accordance with the American systematists Riley, Monell,* and Thomas,† that these longer terminals have as much right to be considered true articulations, as those we find in *Chaitophorus*; and this, coupled with the extreme shortness of the rostrum, and the different habits of life, I think quite justifies us in the separation of *Callipterus* from the group to which *Lachnus* belongs.

Although the dark cloudings which border the veins of the upper wings of these insects are not to be found in all the species—and, indeed, are not peculiar to *Callipterus*, yet they give an elegant and marked character to the *Aphis*, which should not be disregarded in the notes of their diagnosis.

As a rule, their bodies are light in weight, and prettily barred with rich brown on a yellow or greenish ground colour. The wings are voluminous, and possess the same number of veins and furcations as in all the genera previously described.

The *Callipteri* nowhere form large companies or swarms like *Aphis* proper, but affect a more solitary habit of life, only two or three being usually found under one leaf. The hazel *Aphis*, however, will sometimes congregate to fifty or more under a single leaf. These, probably, are the progeny of a single parent, often to be found amongst them.

* 'Notes on Aphididæ of the United States.' Riley and Monell, 1879. P. 28, *et seq.*

† 'Eighth Report on Noxious and Beneficial Insects of the State of Illinois.' By Prof. Cyrus Thomas. P. 109.

I do not see characters sufficiently distinct between *Myzocallis* of Passerini and *Callipterus* of Koch, to necessitate a separate genus. I have, therefore, united these insects under one head.

CALLIPTERUS BETULARIUS, *Kalt.*, Plate LXXXVII.

Aphis tuberculata, Heyden (?).

„ *antennata*, Kalt. (?).

„ *betulae*, Walk.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·090 × 0·030	2·27 × 0·76.
Length of antennæ	0·110	2·80.
„ cornicles	0·005	0·12.

Linear, wholly green, slightly ochreous in the anterior parts, shining, very rugose from the presence of tubercles, each of which is furnished with a tuft of capital hairs as in *Chaitophorus*. Front hairy; eyes red; antennæ very long, seventh joint twice as long as the sixth. Cornicles short and trumpet-like. Tail obtuse and small.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·240	6·09.
Size of body	0·075 × 0·025	1·89 × 0·62.
Length of antennæ	0·140.	3·60.
„ cornicles	0·005	0·12.

Linear, wholly bright green, not so pilose as the apterous larva. Antennæ long, and ringed with brown. Seventh joint at least twice the length of the sixth.

Abdomen edged with small tubercles. Nectaries and tail green. Legs long and green. Wings moderate. Points rather rounded. Stigma, cubitus, and

other veins pale green. Body and legs pilose, but not tufted with cotton. The wing veins are not expanded or clouded at their tips, as in *C. betulicola*. A reference to the plates will show that the venation also is differently disposed in these insects, both of which, however, feed on the same tree.

Apterous oviparous female.

	Inch.	Millimètres.
Size of body	0·165 × 0·075	4·18 × 1·89.
Length of antennæ	0·140	3·60.
,, cornicles	0·007	0·17.

Long and fusiform. Abdomen large and pointed; the last rings dilated much as in the genus *Drepanosiphum*. Colour amber-brown or darker, with six or seven interrupted rusty-brown cross-bars, the third, fourth, fifth, and sixth of which are furnished with round, whitish tubercles. Antennæ and legs stout, long, and green. Tarsi dark brown. Eyes red.

The winged male is much like the winged viviparous female. The perfect sexes may be captured in October, at which time the female commences to oviposit on the common birch and on the weeping variety of the same tree.

This fine insect is more common than *C. betulicola*. I have repeatedly taken it from August to October near Chichester, and on the birches round Haslemere in Surrey.

CALLIPTERUS BETULICOLA, Kalt. (?). Plate LXXXVIII, figs. 1—3.

Aphis betulicola, Kalt. (?), Walk.
Callipterus betulæ, Koch.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·110 × 0·035	2·80 × 0·88.

	Inch.	Millimètres.
Length of antennæ	0·120	3·04.
„ cornicles	0·005	0·12.

Colour yellowish green. Form long oval, apex pointed. Eyes fine red. Antennæ very long, longer than the body, and ringed with black. Cornicles very short, body setose. Cauda inconspicuous.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·380	9·64.
Size of body	$0\cdot110 \times 0\cdot030$	$2\cdot80 \times 0\cdot76.$
Length of antennæ	0·180	4·56.
„ cornicles	0·005	0·12.

Long oval, almost fusiform. Abdominal apex acute. General colour bright green. Head with an obscure linear brown patch, and obvious stemmata. Antennæ very long, ringed with black at the joints, and often decked with cottony tufts. The seventh joint nearly equal to the sixth. Thoracic tubercles and scutellum warm brown. The antennæ rise from obscure frontal tubercles. Abdomen mottled green, more or less dusted with fibrous matter; lateral edges furnished with minute warts. Cornicles about twice as long as broad. Cauda small, pointed, and hairy. Legs very long, green, with black knees and tarsi; irregularly tufted. Sternum with a dark squarish patch. Rostrum reaches to the second coxae. Wings slightly fuscous, long, and narrow, pointed at their apices; costa and stigma pale green; other veins brown and clouded at their ends. The pupa is coloured much like the larva.

This fine insect locates itself in small companies at the summits of the shoots of the birch *Betula alba*. It is very active and runs just before taking wing. It has some resemblance to *D. platanoides*. Though perhaps not very plentiful anywhere, it may be taken

at Critchmere and other localities near Haslemere, from April to July.

This insect shows considerable variation as to tint and markings. Walker describes several such in the 'Ann. of Natural History.' He there notices the oviparous female and the winged male as coupling during September and October.

Several birch-inhabiting Callipteri have been described by American authors. *Callipterus betulecolens* of Riley and Monell has much in common with *Aphis betulicola*, Kalt.; *Callaphis betulella* of Walsh, is difficult to identify; but failing other reasons, should not be separated from *Callipterus* on account of any accidental absence of a stigmatic vein. This vein seems to be the most persistent wing vein in all Aphides. In America, Prof. Cyrus Thomas shows that these insects range from the Eastern coast throughout Mississippi and Illinois States. The last author notices that the stigmatic veins are obsolete at their bases, which peculiarity I have not remarked in the British species.

CALLIPTERUS CORYLI, Goetze. Plate LXXXVIII, figs. 4—7.

Aphis coryli, Goetze, Sir O. Mosley, Kalt:
Callipterus coryli, Koch.
Myzocallis coryli, Pass.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·070 × 0·030	1·77 × ·076.
Length of antennæ	0·050	1·27
„ cornicles	0·005	0·12

Smaller than *C. carpini*, which it somewhat resembles. Almost white and transparent, shining; whole body tuberculate and studded with capitate bristles. Eyes red. Antennæ shorter than the body, ringed

with black. Nectaries pale. Tail large and obtuse. Legs short.

The Pupa.

Less linear than the pupa of *C. carpini*, which Passerini considers to be identical with *C. coryli*.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·265	6·72.
Size of body	0·065 × 0·025	1·64 × 0·62.
Length of antennæ	0·060	1·52.
„ cornicles	0·007	0·17.

Wholly pale yellow, or else citron yellow. Head rather broad. Vertex prominent. Cornicles yellow. Legs short. Wings hyaline and not clouded with brown. Insertions, stigmata, and veins yellowish green.

Sometimes this little *Aphis* swarms by hundreds under the leaves of the hazel, *Corylus avellana*; forty or more being crowded on a single leaf. At other times the *Aphis* shows a more solitary habit. Kaltenbach says it affects also *Carpinus betulus* and even *Fraxinus excelsior*. Their activity appears to be much less than that shown by the *Callipterus* of the birch.

Walker says that this nut-*Aphis* is much preyed on by the little *Myina flava*, which insect is also parasitic on *C. quercus* and perhaps on *Pterocallis tiliæ*.

The oviparous female greatly resembles the viviparous female, but the abdominal apex has a squarish termination, and the last ring is furnished with well-marked genito-anal valves. Several specimens were secured in the month of November, and they contained from three to five forward ova. Most of the hazel-tree leaves had then fallen, and the rest were dry and yellow. Probably the eggs, when mature, are deposited in crevices of the bark. Nevertheless, I have failed to find them in such places.

CALLIPTERUS CARPINI, Koch. Plate LXXXIX.

Aphis coryli, Kalt. (?).*Apterous viviparous female.*

	Inch.	Millimètres.
Size of body	0·090 \times 0·045	2·27 \times 1·13.
Length of antennæ	0·085	2·14.
„ cornicles	0·007	0·17.

Large, wholly pale yellow or greenish ; resembles *Callipterus coryli*, but its habits are different and proportions unlike. Body covered with capitate hairs. Antennæ shorter than the body. Very active, running from one side of the leaf to the other when disturbed ; several individuals congregate on the same leaf of *Betula tremula*, and, according to Koch, also on *Carpinus betulus*. Common near Chichester from June to October.

The Pupa.

Long oval, attenuated behind. Head broad, vertex pilose. Body pale shining green, covered with capitate hairs, but some specimens are smoother than others. Antennæ as long or longer than the body, and ringed with black ; the seventh joint twice as long as the sixth. Rostrum does not reach to the second coxae. Cornicles very small, generally black at the tips. Legs and wing-cases pale green.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·380	9·64.
Size of body	0·120 \times 0·040	3·04 \times 1·01.
Length of antennæ	0·140	3·55.
„ cornicles	0·002	·05.

Large, bright green, slightly tuberculate. Rather mealy. Head and prothorax with a dull brown spot. Antennæ brown, long ; seventh joint only equals the

length of the sixth, but is somewhat variable in length. Thoracic lobes brown. Abdomen slightly ringed. Nectaries very small. Cauda yellow and rather large. Legs moderately long. Wings pointed. Cubitus and stigma yellow. Other veins pale brown and clouded at their tips. Often the cubital vein does not touch the cubitus.

Apterous oviparous female.

	Inch.	Millimètres.
Size of body	0·100 \times 0·050	2·54 \times 1·27.
Length of antennæ	0·040	1·01.

Less linear than the pupal form. Bright yellow tinged with crimson. A crescental brown mark on the head carried over the thorax. Abdomen with a broad brown bar followed by three or more other interrupted bars, and a very broad patch of the same colour on the lower dorsum. Tail elongated into a kind of ovipositor and tipped with bristles. Antennæ and nectaries very short. The seventh joint of the latter reduced almost to a "nail."

Apterous male.

Very small. Bright yellow, or pale brick-red, with a red dorsal stripe crossed by seven or more transverse stripes of the same colour, thus giving a gay appearance to the insect. These males are not uncommon in early October, when they mix with the oviparous forms. Their bodies are internally crowded with oily globules, which in great measure furnish the general ground colour of the insects, pigment being alone deposited in the fascial marks. Dissection clearly proved the sex of these specimens.

Winged male.

These insects are more brilliant in colour and banding than the other forms. Ground colour fine yellow,

head, thorax, and abdomen banded and spotted with rich brown. The antennæ are longer, and the stigmata are more of a grey shade than with the females.

This species furnishes one more example of the *dimorphism* of the males, and points out the plasticity of this insect family under the varying action of local surroundings.

At present we are ignorant whether or no there be any modification of form in the insects hatched from the broods of these different paternities. If there should be any difference, the circumstance would have considerable interest with the morphologist.

CALLIPTERUS QUERCÙS, *Kalt.*, Plate XC.

Aphis quercùs, *Kalt.*, *Walk.*, *Ratz.*

Callipterus quercùs, *Koch.*

Myzocallis quercùs, *Pass.*

Apterous oviparous female.

	Inch.	Millimètres.
Size of body	0·080 \times 0·040	2·02 \times 1·01.
Length of antennæ	0·060	1·52.
„ cornicles very small.	„	„

Flat, oval, pale green or yellow, some examples are almost colourless; front bristly. Antennæ not so long as the body; pale, ringed with brown. Eyes brown or reddish. Abdomen with two rows of brownish transverse dashes, and six or more tubercles with capitate bristles on each lateral edge. Cornicles green and very short.

Pupa.

Paler than the larva. Wing-cases and legs pale yellow-green. More hirsute than the last-described form.

Winged viviparous female.

	Inch.	Millimètres.
Expanse	0·260	6·60.
Size of body	0·090 \times 0·030	2·27 \times 0·76.
Length of antennæ	0·085	2·14.
„ cornicles	very small.	

Pale green or light yellow. Antennæ at least equal in length to the body, ringed with black. Seventh joint about equal to the sixth. Nectaries green, sometimes tipped with brown. Abdomen occasionally obscurely barred with brown, and furnished on the dorsum with six pointed tubercles disposed in two rows, unobserved by Koch. Rostrum very short, not reaching to the second coxæ.

This species is common on the sessile oak, *Quercus sessiliflora* from spring to October. I have taken it feeding also on *Quercus ilex*; and Walker observed it on the American chestnut, *Castanea pumila*. They form small companies of four or six under the same leaf, and they intermix with the next species, *Callipterus querceus*, and *Thelaxes (Vacuna) dryophila*.

The young are nearly white or colourless, with eyes more or less spotted; by age these last organs become red.

Apterous oviparous female.

	Inch.	Millimètres.
Size of body	0·080 \times 0·045	2·02 \times 1·13.

Fine yellow or salmon-colour, with greenish dorsal stains, which dilate near the tail. Body ringed, tuberculate, and hirsute. Eyes spotted with brown. Geneto-anal rings obtuse and rounded. Rostrum as with the other forms.

Taken at the end of November whilst ovipositing on a dry leaf. They, however, will oviposit also in the middle of October.

As these leaves fall to the ground, it is probable that

the eggs of some species of Aphides pass the winter on or under the ground, and the young *Aphis* commences active life at the return of spring warmth as the leaves push forth.

It has been before noticed that the only memoir on the reproduction and morphology of Aphides in English, which is worthy of the name of a scientific treatise, is from the pen of Professor Huxley. In this elaborate paper Professor Huxley points out the significance of the ovarian tubes and the adjuncts which appertain to the perfectly-sexed female; and subsequently he shows the representatives of these organs in the chambers of the pseudovaria, &c., in the viviparous female. To illustrate these latter details, Prof. Huxley selected for experiment the common species *Aphis pelargonii* (*Siphonophora*), and there can be no reasonable doubt of the identity of the species he dissected. The same certainty, however, does not appear to attach to the second species chosen to illustrate the evolution of the true ovum.

Perhaps some knowledge as a specialist is required at once to fix on the salient characters of a particular form of *Aphis*, and thus there is little cause for wonder that some obscurity attaches to the specific name assigned in this paper by Huxley to the oviparous females he examined.

At the end of his memoir Professor Huxley, whilst expressing his belief that the Aphides he obtained from the oak were *Vacuna dryophila* of Schrank, does not speak with complete confidence, but states "that his insect had certainly seven joints to the antennæ." Yet *Vacuna* certainly has but six, even if we count the nail-like terminal process as one. Again, in the diagnosis of the species, it is stated that the body is covered with setose tubercles, that it has trumpet-mouthed syphons, and that the abdomen is ornamented with transverse rows of dark spots, each row representing a segment. These characters certainly better accord with those of the genus *Callipterus* than with those of

Vacuna. Professor Huxley has kindly compared two of his own pencil sketches with drawings I have made of these two genera, and with the sincerity of a truth-seeker he writes that "The former appear to me to agree with your *Callipterus quercus* more nearly than with any other species among those you have figured." I may say also that these sketches were kindly forwarded to me, and that to my mind they had all the peculiarities attaching to *Callipterus*.

A settlement of this question is of the more importance, since the genus *Vacuna** must be considered somewhat removed from the typical *Aphis*, and we might therefore, perhaps, expect a somewhat varied parallelism between the morphology of the perfect and imperfect sexes of the genera *Siphonophora*, *Callipterus*, and *Vacuna*.†

CALLIPTERUS QUERCEUS, *Kalt.*, Plate XCI, figs. 1—4.

Aphis quercæa, *Kalt.*, *Ratz.*, *Walk.* (?).
Myzocallis quercæa, *Pass.*

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·070 \times 0·035	1·77 \times 0·88.
Length of antennæ	0·060	1·52.
„ cornicles very small.		

Smaller than *C. quercus*. Variable as to its markings. General colour darkish green mottled with brighter green. Cornicles tipped with black, about the length of the body, and tinged with black. Eyes usually spotted with red.

* The genus *Thelaxes* of Westwood has priority over *Vacuna* of Heyden, but I have retained the latter name here as it appears in Professor Huxley's papers.

† Huxley "On the Morphology of *Aphis*," "Trans. Linn. Soc., vol. xxii, part 3.

VAR. I.—*Winged viviparous female.*

	Inch.	Millimètres.
Expanse of wings	0·180	4·56.
Size of body	0·070 \times 0·025	1·77 \times 0·62.
Length of antennæ	0·080	2·02.
,, cornicles	0·002	0·05.

Very small. Bright green with pale thoracic lobes. Head and prothorax very large. Eyes large, bright red. Antennæ nearly white, with dark spots at the joints. Seventh joint rather longer than the sixth. Abdomen mottled with paler green. The third ring has two pointed dorsal processes. Legs whitish and short. Cornicles very small, and tipped with black. Wings short and rounded at the tips. Costa much curved, as also is the cubitus. Cubital vein forms in curvature almost the segment of a circle; furcations almost equally long. Cauda very obtuse.

VAR. II.—Possibly the produce of an earlier birth.

Much larger. Expanse of wings 0·240 inch. Colour similar to the foregoing, but the thoracic lobes are olive-green, and the abdomen is tinged with orange. Seven or more crescentic bands are ranged down the dorsum. Wings longer than in the preceding variety, and not quite so much curved as to the costa. Eyes pink, spotted with red.

Winged male.

	Inch.	Millimètres.
Expanse of wings	0·210	5·35
Size of body	0·060 \times 0·020	1·52 \times 0·50
Length of antennæ	0·080	2·02
,, cornicles	very small	

Small, cinereous green. Head and thorax very broad. Antennæ and legs ashy. Wings rather long, greyish. Cubitus and stigma sooty brown. Veins black, and clouded slightly at their apices. November.

This species seems to vary considerably as to size and form, so much so, as to leave me in some doubt as to whether the insects I now describe are really identical with those of Kaltenbach and Walker. Kaltenbach mentions the occurrence of a green tubercle which is furcate on the second ring (abdominal ?), and that two or three tubercles are to be found on the lateral edges. Neither of these characters are given by Walker, and I do not find them in my specimens as thus set forth.

Taken on *Quercus robur* at Weycombe and at Wanstead, Essex. According to Passerini the Italian insects are all more or less clothed with down.

CALLIPTERUS CASTANÆÆ, Buckton. Plate XCI, figs. 5—9.

Callipterus castanææ, Fitch (?).

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·060 \times 0·035	1·52 \times 0·88.
Length of antennæ	0·035	0·88.
,, cornicles	0·002	0·05.

Body ovate, somewhat flat, pale green or yellowish. Front convex, and furnished with bristles. Head and thorax broad. Two rows of dark brown or greyish spots, eight or nine in number, ranged down the dorsum, which rows are continued through the thorax. Four or five similar marks occur near the stomata. Antennæ pale green, with black articulations. Eyes black. Tail rounded and hairy. Rostrum very short. The whole body covered with capitate hairs.

This insect is somewhat solitary in habit. It is plentiful at Haslemere in the copses of the sweet chestnut, *Castanea vesca*, from early May to December. Towards the end of Autumn the brown bandings on the abdomen have a tendency to increase in breadth and so they make the insect darker in tint.

The Pupa.

Bright yellow, with very few brown markings ; body very pilose. Shape rather globose.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·200	5·08.
Size of body	0·055 \times 0·025	1·39 \times 0·62.
Length of antennæ	0·060	1·52.
,, cornicles	0·002	0·05.

This is an elegant little species. Colour bright citron yellow, prettily marked with brown squarish spots. Head and thorax broad. Front convex, marked by a fine band, and this is followed by a series of fine dashes through the prothorax. Three longitudinal dashes mark the thoracic tubercles. Abdomen oval, smooth, and ornamented with four rows of horizontal oblong spots ranged down the dorsum. The number of spots, however, is not abundant. Cornicles very short and brown. Legs moderately long, hairy. Antennal third joint tuberculate, the seventh joint equal to the sixth. Wings rounded, with yellow insertions, cubitus, and other veins. Stigmata pale brownish, with a darker clouding at the anterior and posterior angles. Veins expanded at their apices into brown cloudings. Eyes in the adults bright red, but in the freshly emerged imagos they are spotted.

Apterous oviparous female.

Much like the form and colour of the last, but the dark bandings cover more of the insect. Tail and nectaries pale green. On December 4th a specimen was confined by a bag of gauze to the twig of chestnut on which she was located. After she had laid a certain number of eggs she was dissected under some weak syrup, and as many as thirteen eggs were obtained from her, all of which were in a forward state of maturity.

The lowest temperature of the previous night was 21° Fahr. The naturally extruded eggs were black, but they were not of a true oval form, being attenuated at one end, and deeply corrugated. Those within the abdomen were of a normal shape. The collateral glands, close to the vaginal orifice, were well made out under the microscope; also dissection showed a well-marked expansion of the alimentary canal into a distinct but somewhat small stomach. The presence of this organ shows that the perfect sexes therefore are capable of taking nourishment, which is not the case in some species of *Aphis* lower in the scale of development.

This appears to be a species hitherto undescribed in Europe.

In America, however, Fitch has described, under the name of the "Chestnut Gay-louse," a sulphur-yellow *Aphis*, which may prove to be identical with the above British species. The measurements (0·09 inch) and wing cloudings differ, however, and there are other minor points, which make it unsafe to decide the point without inspection of the continental species. I place Fitch's insect, therefore, as a doubtful but probable synonym.

I.

APHIDINÆ.

SECTION

LACHNINÆ, PASS.

UPPER WING WITH A BIFURcate CUBITUS.

LOWER WING WITH TWO OBLIQUE VEINS.

ANTENNÆ SEX-ARTICULATE.

LACHNINÆ.

This section includes a number of insects, which show sufficient peculiarities of structure to allow a definite separation from the foregoing Aphidinæ. The few genera comprised in this group are perhaps best typified by Illiger's old genus *Lachnus*, which furnishes three very fine characteristic species, all of which are inhabitants of the oak-tree.

As to the wing-venation, the *Lachninæ* do not much depart from the species hitherto described in this Monograph, but the positions and the curvatures of the veins somewhat differ. The forking of the cubital vein still obtains, but in the less developed species there seems to be a tendency to the suppression of the second oblique vein of the lower wings. This occurs only in abnormal specimens.

The antennæ are reduced in length, and this is in great measure caused by the loss of the seventh joint, which is reduced to the condition of an elongated button or papilla.

GENUS XVII.—PTEROCALLIS,* *Passerini*.

Rostrum stout and short, scarcely reaching beyond the first coxae.

Antennæ shorter than in *Callipterus*, six-jointed, the usual seventh joint being represented by a sudden thinning off of the extremity of the sixth.

Cornicles small and tubercular.

Wings rather shorter than in *Callipterus*. The membrane sometimes clouded or brocaded.

Passerini gives as a character, “Alarum anteriorum venæ obliquæ apice in maculam fuscam amplam triangulam dilatatæ.”

PTEROCALLIS ALNI, *Fabr.* Plate XCII, figs. 1—4.

Aphis alni, *Fabr.*, *De Geer*, *Kirby* and *Spence*,
Kalt., Walk.

Callipterus alni, *Koch*.

Pterocallis alni, *Pass.*

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·080 \times 0·035	2·02 \times 0·88.
Length of antennæ	0·050	1·27.
„ cornicles	0·005	0·12.

Oval, transparent, pale green; blotched at the sides and across the dorsum with dark green. Body sometimes wholly pale green and without blotches. Eyes warm brown. Antennæ whitish, with the tips of the last three joints black. Abdomen carinated and covered with tubercles, from each of which tufts of hair rise. Cauda obtuse. Cornicles very small, green in the young individuals, but tipped with black in the

* From πτερόν, a wing, and καλλος, beautiful.

adults. Tarsi black. Rostrum very short, reaching only to the first coxae.

This insect, as a larva, is very like *Callipterus coryli*, but the hairs are non-capitate. Taken on the Alder, *Alnus glutinosa*, at Haslemere and at Edgware towards the end of May.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·230	5·84.
Size of body	0·070 \times 0·030	1·77 \times 0·76.
Length of antennæ	0·090	2·27.
„ cornicles	0·005	0·12.

Small, wholly bluish or yellowish green. Eyes brown. Antennæ long and ringed with black. Sixth and rudimentary seventh joints very short; together not equal to the fifth. Abdomen slightly tuberculous. Nectaries very small. Legs pale green and short. Rostrum very short, rather beyond the first coxae. Wings moderately long. Cubitus and costa green. Stigmata grey. Veins very slender, with a tendency to expand at their apices into a cloudiness. Habits active, but rather solitary; one, or two insects at most, being found under a single leaf. The winged female occurs at the end of June. Two anal papillæ (after-lappchen) are obvious.

PTEROCALLIS JUGLANDICOLA, Kalt., Plate XCII, figs. 5—8.

Lachnus juglandicola, Kalt.

Aphis juglandicola, Walk.

Callipterus juglandicola, Koch., Pass.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·055 \times 0·030	1·39 \times 0·76.
Length of antennæ	0·020	0·50.
„ cornicles	0·002	0·05.

Small, oval, pale greenish or bluish yellow. Eyes red. Body finely setose; hairs capitate. Young specimens are nearly divested of all markings, but the adults have two longitudinal rows of black dorsal spots. Rostrum very short, reaching just beyond the first coxae.

Pupa.

	Inch.	Millimètres.
Size of body	0·065 \times 0·032	1·64 \times 0·80.
Length of antennæ	0·060	1·52.

Considerably larger than the foregoing insect. Colour yellow, green, and ferruginous. Wing-cases pale bluish. Abdomen with four rows of black spots. Koch states that the antennæ are shorter than those possessed by the apterous female. The example I figure differs in this respect.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·180	4·56.
Size of body	0·065 \times 0·025	1·64 \times 0·62.
Length of antennæ	0·035	0·88.
„ cornicles	0·002	0·05.

Wholly bright yellow or orange colour. Thoracic lobes rather orange-brown. Antennæ short, tips of the joints black. Rudimentary seventh joint about half the length of the sixth.* Abdomen nearly transparent, usually showing the internal tracheæ. Legs and nectaries wholly yellow. Wings moderately long; the costa and cubitus somewhat curved inwards. All the veins, the insertions, and stigmata fine yellow. The anal ring is furnished with two papillæ, which are crenated.

* On account of the size of the seventh antennal joint possibly this species might be ranged under *Callipterus*; I leave it, however, where Passerini has placed it.

Apterous oviparous female.

Hirsute, greenish yellow, with two involuted black marks on the thoracic region, and three black confluent bands on the abdomen. The antennæ are short and ringed with black. Legs green, with isolated black spots at the tips of the femora. Cauda rounded. The example figured was captured at the end of July, and even at that early season it contained two large eggs. Walker obtained females with four eggs. The same observer describes the male as winged, like the viviparous female, but more slender of form.

This species feeds, and close to the rib-veins, on the under surfaces of the leaves of the walnut tree, *Juglans regia*. It occurs from May to October, but it is not common.

PTEROCALLIS TILIÆ, Linn., Plate XCIII.

Aphis tiliæ, Linn., Réaumur (?), De Geer, Schr., Walk.

Callipterus tiliæ, Koch.

Pterocallis tiliæ, Pass.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·080 \times 0·035	2·02 \times 0·88.
Length of antennæ	0·060	1·52.
„ cornicles	0·005	0·12.

Long oval, shining green or yellowish. Head and prothorax black. Eyes red. Thorax with a large square spot flanked on each side by another spot. Abdomen domed and crossed by numerous black bands. Carina with spots corresponding to the same. Antennæ, tail, and legs green; the former ringed with black. A distinct and fine line cuts across the occipital and the five or six abdominal fasciæ. Some individuals are almost uniform in colour and without bands.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·280	7·10.
Size of body	0·100 \times 0·025	2·54 \times 0·62.
Length of antennæ	0·080	2·02.
,, cornicles	0·002	0·05.

Bright yellow. Two fine waving black lines run behind the eyes, which are continued down each side of the prothorax. Two irregular lines mark the thoracic lobes. Five black dots occur on each side of the dorsum. Antennæ yellow, with black rings. Tarsi and hind femora black. Genito-anal plates conspicuous. Wings ample; insertions, cubitus, and stigmata dark grey. Other veins grey, and broadly clouded at their apices. The stigma, which is large, has a dark stain at its inner margin. The rostrum is very short, and hardly exceeds the length of the head.

Pupa.

Rich lemon-yellow, sometimes pale green. Wing-cases greenish. Antennæ as long as the body.

Winged male.

	Inch.	Millimètres.
Expanse of wings	0·260	6·62.
Size of body	0·050 \times 0·030	1·27 \times 0·76.
Length of antennæ	0·090	2·27.

Body small in proportion to the voluminous wings. Not unlike the female in colour. Head streaked with black. Antennæ very long and ringed; the third joint much tuberculate. Eyes bright red; stemmata prominent and green. Dorsum with two rows of black spots. Wings prettily clouded with grey. Appears in September and October.

Walker states that this Aphis, like some others, has a supplementary wingless male. He describes the oviparous females as yellow; flat, and hairy, with broad

tibiæ. They usually contain as many as six ova in various conditions of maturity.

This *Aphis* appears to restrict its food to several species of the lime or linden tree. It attacks *Tilia rubra*, *T. platyphyllea*, and *T. grandifolia*, the leaves of which shelter thousands on their under sides. They eject the honey-dew in such quantity, that Kaltenbach remarks that the traveller may trace the *Aphis* by the viscid liquid which it sheds on the ground. In Switzerland, the Aphides sometimes almost kill the trees; and at times so exhaust them of sap, that Boussingault calculates that a single sick tree may produce as much as three kilogrammes of sweet substance, which is entirely the produce of *Pterocallis tiliæ*,* and elaborated from the juice.

This *Aphis*, fortunately, is largely destroyed by various parasitic Hymenoptera. As many as twenty-four grubs may sometimes be counted infesting a single *Aphis*, but at other times one large maggot occupies almost the whole body-cavity, and apparently without attacking the nervous centres, since the host lives on and travels with its guest, as heavy as itself. Such an example, on a smaller scale, I have figured in Vol. II, Plate XLIII, fig. 6.

The *puceron de tilleul* of Réaumur must be referred to a different genus from the ordinary lime *Aphis*. Réaumur describes the insects as ranging themselves in single file on one side of the leaf-stalk, and states that by so doing they cause the stalks by their punctures to curve into the form of corkscrews, the growth being arrested on one side only. Réaumur also gives a figure of this distortion. Kaltenbach points out that Linnæus and Fabricius, both quoted from Réaumur, and this was copied into Müller's translation of the 'Systema Naturæ.' Kaltenbach and others long failed to find this "strongly convex" *Aphis*, which lives in companies. Kaltenbach says it cannot be confounded with

* *Vide* Boussingault, "On Honey-dew;" vol. i, p. 42, of this Monograph.

the ordinary flat lime Aphis. He remarks, however, that in 1842, "I had the luck to discover them on two sheltered lime-trees," and then he refers the reader to *Schizoneura Réaumuri* of his work.

Kirby and Spence mention a gall on the lime-tree, and also on the willow, both of which they say are the produce of Aphides, but it is doubtful to what species these have reference.

GENUS XVIII.—PHYLLAPHIS,* Koch.

Rostrum very short.

Head convex, smooth.

Antennæ moderately long, the third joint about double the length of the fourth; the fifth and sixth joints equal, the sixth furnished with a representative nail.

Cornicles hardly visible, and lying flat to the body.

Cauda almost obsolete.

Body furnished with long flocks of wool-like fibre of a waxy nature.

Wings long and broad. Stigma long and trapezoidal. Nervures not clouded.

Legs moderate in size.

PHYLLAPHIS FAGI, Linn. Plate XCIV.

Aphis fagi, Linn., Fab., Walk.

Lachnus fagi, Burm., Kalt.

Phyllaphis fagi, Koch, Pass.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·090 \times 0·035	2·27 \times 0·88
Length of antennæ	0·060	1·52.
Cornicles wartlike		„

* From φύλλον, a leaf.

Body long, bright green or yellowish green, narrow across the thorax. Abdomen, in the adults, spotted with green in longitudinal rows, broadest on the tergum. Cornicles mere tubercles, which scarcely rise above the general surface. Antennæ greenish yellow, and equally stout throughout; the last joint has a process which Koch and some others regard as a true joint. Eyes large and red.

The insect, during the summer, conceals itself from observation by means of a quantity of white silky material spun from pores spread on the thorax, and more plentifully on the abdominal rings. This cottony matter occurs in long flocks, which extend beyond the tail, and make the insect apparently double its real size. These insects crowd under the leaves of the common beech, *Fagus sylvestris*, and render them hoary with this cottony mass.* Occasionally this accumulates into resinous lumps, which have a sweetish flavour on the tongue. Young specimens are but little clothed, and, singularly, towards November the adults spin less of this flocculent material.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·300	7·62.
Size of body	0·110 × 0·040	2·79 × 1·01.
Length of antennæ	0·060	1·52.
Cornicles wartlike		„

Head and thorax rather slender. Abdomen long oval. Colour yellowish green. Head, prothorax, and thoracic lobes black. Eight or more broad bands and as many lateral spots mark the abdomen. Legs and antennæ black. The latter spring from inconspicuous frontal tubercles. The sides and apex of the abdomen are garnished with long flowing flocks as in the wingless female. Anal plates unmarked.

* As this substance is soluble in ether, it has more the character of wax than either silk or cotton. Coccus, an allied family, as is well known, produces both resin (lac) and wax (Chinese wax).

Wings with the membranes rather bronzed. Cubitus and veins brownish black. The former expands into a fuscous and longish trapezoidal stigma.

This handsome fly is common in June wherever varieties of the beech-tree abound.

The males.

Walker describes the winged male, which I have not seen, but I have taken the apterous male in company with the female late in October. It is rather small and linear, its size $0\cdot085 \times 0\cdot025$ of an inch; bright green, rostrated, and furnished with short and stout legs.

Apterous oviparous female.

	Inch.	Millimètres.
Size of body	$0\cdot070 \times 0\cdot030$	$1\cdot77 \times 0\cdot76$.
Length of antennæ	$0\cdot030$	$0\cdot76$.

Colour of different shades, as bright green or reddish. Some are destitute of all markings, but others have brown spots ranged down the back and sides. The flocculent substance is most plentiful on the lower somites. They contain from six to eight eggs. They appear from October to late in November, according to the coldness or advanced character of the season.

GENUS XIX.—PTYCHODES,* *Buckton.*

Rostrum very short and stout.

Head convex and broad, tufted with bristles.

Antennæ stout; first and second joints gibbous, the third longer than the three following taken together, the fourth and fifth nearly equal, the sixth joint furnished with a nail-like process, as in *Phyllaphis*.

* From πτυχώδης, striped or striated.

Abdomen fusiform, banded with colour.

Cauda small, pilose; anal valves very marked.

Cornicles small, and buccinate in the winged females.

Legs robust, short, and pilose.

Wings much shorter and narrower than in *Callipterus*; cuneate at the tips; cubitus strong, nervures dilated at their ends into triangular fuscous spots.

PTYCHODES JUGLANDIS, Frisch. Plate XCV.

Aphis juglandis, Frisch.

Lachnus juglandis, Kalt., Walk.

Callipterus juglandis, Koch, Pass.

It is remarkable that no description of the apterous viviparous female of this species has yet been given by any author. I have never met with it myself, although not a few examples of the other forms have come under my observation. This peculiarity recalls the circumstance that the apterous viviparous female of *Drepanosiphum platanoides* is also unknown. Thus these very different species would seem to show in their metamorphosis a similar characteristic, which amounts to this, that every insect which hatches from the egg assumes wings before it commences its viviparous multiplication. Unlike other species of *Aphis*, every so-called larval form directly passes into a pupa and thence into its imago.

Pupa.

	Inch.	Millimètres.
Size of body	0·120 \times 0·055	3·04 \times 1·39.
Length of antennæ	0·030	0·76.
„ cornicles	0·004	0·10.

Long oval. Head broad. General colour fine yellow tinted with brown and greenish shades. Head with an irregularly cleft rich brown mark, followed by

four others on the prothorax. Abdomen furnished with four longitudinal rows of squarish spots, so disposed as to give much the appearance of transverse bands. The very short cornicles are each seated on one of the lateral posterior spots. Wing-cases very pale, and edged with brown. Eyes red. Antennæ very short and tipped with brown. Rostrum hardly longer than the head. Legs pale grey; hind pairs very stout. The whole insect is pilose. The young insects are born without wing-cases.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·360	9·14.
Size of body	0·130 \times 0·050	3·30 \times 1·27.
Length of antennæ	0·060	1·52
,, cornicles	0·005	0·12

Large, bright yellow. Head, band on prothorax, thoracic lobes, and metathorax brown. Abdomen yellow, with seven more or less interrupted transverse brown bars flanked by two rows of marginal spots. Cornicles very short, with their bases brown. Antennæ short and very slender, the seventh joint being represented by an obtuse claw or nail. Legs short, hairy, and stout.

Wings small and narrow for the size of the body. Costal nerve and cubitus brown; stigma paler; other veins brown, and expanded at their apices into brown cloudy stains.

This handsome *Aphis* differs in several respects from previously described allied forms. The shortness of the antennæ and the aborted seventh antennal joint, coupled with its very different shape, require its exclusion from the last genus. Again, some significance would attach to its modified metamorphoses, and perhaps, too, from its habit of feeding exclusively on the *upper* surfaces of the leaves of *Juglans regia*, a habit not noticeable in *Pterocallis juglandicola*, the

other walnut species. Its bright colouring accords well with its more exposed situation, and may act as a protection from its enemies. From these considerations I propose to place it in the above new genus; and this procedure will be in accordance with Mr. Walker's views on the subject, as set forth in the 'Zoologist,' 2nd series, vol. v, p. 200.

GENUS XX.—LACHNUS,* *Illiger.*

KIENLÄUSE. BAUMLAUS. PINE APHIS.

Rostrum slender, very long, always longer than half of the body, and sometimes considerably longer; last joints hastate.

Antennæ short, six-jointed, the last joint ends with a nail-like process, which is the representative of the seventh joint of other genera. The first two joints are short and thick; the third long, as long as the two following taken together; the fourth, fifth, and sixth joints are equally long.

Cornicles small, not longer than broad.

Cauda none, or inconspicuous.

Legs very long, particularly the hinder pair; the tibiæ of which, in the oviparous females, are usually dilated. Tarsi biarticulate.

Wings very long and broad, stigmata long and narrow; sometimes considerably encroaching on the extension of the costa; stigmatic cells ovate. Cubital veins twice forked.†

Lower wings with two oblique veins.

The genus *Lachnus* comprises some of the largest

* From λάχναιος, woolly, pilose.

† Kaltenbach describes the antennæ as six-jointed, whilst Koch counts in them but seven joints; for he considers the nail as one. The former author says that he has captured both *Lachnus agilis* and *L. fasciatus* with their cubital veins but once forked. This tendency to the suppression of a wing-vein would seem to indicate a possible passage between two genera; or, viewed from the theory of development, it might show that some individuals only have risen to the higher type.

species known in this family of insects. They are noticeable on account of their varied habits and life-history, and also for their ornate characters. Whilst some kinds confine themselves to the soft rind of the young branches of trees and shrubs, others find sustenance within the crevices of the hard cortex of the oak, the willow, or the pine-tree.

Most species are clothed with a dense fur-like coat of thick hair, which circumstance suggested to Illiger the name *Lachnus*, which implies such a character. Often this protective covering is supplemented by the peculiar flocculent matter seen so remarkably plentiful in *Phyllaphis*. Another characteristic of this genus is the development of the legs, which are robust, and in the hind pair attain to a great length. The hind tarsi are distinctly biarticulate, the last joint with the claws being much more developed than is seen in *Aphis* proper.

The rostrum is abnormally long. This development is most remarkably seen in the rare species *Stomaphis quercūs*, which exhibits the organ more than twice and a half the total length of the body. Considered as a proboscis, this insect has proportionally the longest of all known animals.

The nectaries are in some kinds almost obsolete, but others possess them very small, and expanded as to their mouths.

The tail is almost wanting, in accordance with Kaltenbach's remark, that this organ in its development has a direct ratio to that of the cornicle. But although these nectaries are so short, they do not preclude the insect from the elaboration of honey-dew, for no Aphides are more prolific in this secretion than the *Lachninae*. On this account their presence on the trunks and branches is often betrayed by the long file of ants coursing up and down in quest of the liquid with which they so much like to gorge themselves.*

* The sweet substance found in quantity on some plants in Italy, and known as *manna dei apicollori*, is considered by Cannestrini and others to be the product of certain *Lachninae*. Targioni-Tozzetti gives a chemical analysis of this secretion in the 'Bull. Ent. Ital.' ix, p. 240.

With the exception of the three oak species and the single denizen of the willow, all the known British Lachninæ are feeders on Coniferæ. Of these, some affect the bole of the trees not far from the ground, whilst others confine themselves very much to the higher branches and are difficult to reach.

In order to balance the heavy bodies of these insects, they possess broad expansive wings, which if not adapted for swift flight, are still well suited for floating in the air, and thus they are the means of transporting the alate male to vast distances by help of the changing winds.

Apterous males have been obscurely indicated by Bonnet and De Geer. Koch also saw long narrow green forms amongst the leaves of certain fir trees, which he regarded as males.

Many of the larger kinds of *Lachnus* furnish an intense red stain when crushed, but the elaboration of this dye-like juice is not confined to the Lachninæ.

LACHNUS JUNIPERI, *Fabr.* Plate XCVI, figs. 1, 2.

Aphis juniperi, *Fabr.*, *Schr.*, *Walk.*

Lachnus juniperi, *Kalt.*, *Koch*, *Pass.*

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	$0\cdot110 \times 0\cdot070$	$2\cdot79 \times 1\cdot77$.
Length of antennæ	$0\cdot060$	$1\cdot52$.
,, cornicles	$0\cdot007$	$0\cdot17$.

Very globose, sienna brown, very pilose, rather shining, thoracic ring much corrugated. Abdomen carinated. Head, thorax, and legs pitchy black. Abdomen rich brown, with two large irregular spots from which rise the obtuse and short nectaries. Head broad. Eyes and antennæ black. Under side rather

more red, coxae black, a semilunar patch near the anal plate. Rostrum black, and reaching to the third coxae, or beyond. Tarsi two-jointed. Stomata below, marked by black dots. Some specimens show two tapering bands which pass from the thorax down the upper part of the abdomen.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·420	10·66.
Size of body	0·100 \times 0·050	2·54 \times 1·27.
Length of antennæ	0·050	1·27.
, cornicles	0·008	0·20.

Large, very hirsute. Head and thorax broad. Abdomen globular, wrinkled. Cornicles conical, black, and rising from black spots. Head, thorax, legs, and antennæ shining black. Abdomen rich reddish brown. Wings ample. Membranes brownish; insertions and cubitus yellow. Stigmata brown; veins very slender, the second fork from the cubital vein encloses a very narrow triangular cell. Two black spots on each anal plate. Eyes, rostrum, and stomata black. Cauda none.

Sometimes found in swarms on the common juniper, *Juniperus communis*, at Alnwick and Wooler in Northumberland, and also on the bleak moors of the Cheviott (Hardy). Kaltenbach apparently could only find it on the same shrub ("Wachholder-Strauch, Juniper-shrub,") in moist and warm places. Mr. Hardy has found the black eggs on the twigs, and sometimes plentifully.

De Geer states that the male is apterous.

LACHNUS CUPRESSI, Buckton. Plate CII, figs. 1—3.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·080 \times 0·055	2·02 \times 1·39.
Length of antennæ	0·050	1·27.
„ cornicles	0·005	0·12.

Colour ginger-brown or foxy-yellow. Head large. Legs long and hairy. Eyes, nectaries, femoral and tibial tips, and points of the antennæ, dark shining brown, approaching to black. Rostrum reaches beyond the third coxæ—about three fourths of the length of the body.

Pupa.

Oval, domed, shining yellowish brown, hirsute. Wing-cases honey-yellow. Both these forms are smaller than the winged female.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·340	8·62.
Size of body	0·154 \times 0·035	3·91 \times 0·88.
Length of antennæ	0·040	1·01.
„ cornicles	0·005	0·12.

Colour as with the above. Very hairy. Thoracic lobes, cornicles, femoral and tibial points, brown. Caudal end obtuse and setose. Wings moderately long. Stigma long and dull brown. Other veins black. Stigmatic veins straight and very stout. So also are the second and third oblique veins. Hind legs very long. Cornicles conical, and at their bases surrounded by radiating bristles.

Live specimens of this *Aphis* were kindly forwarded to me through Mr. McLachlan by the Hon. J. T. Boscowen, of Lamorran, Probus, Cornwall. They

were described as doing considerable injury to the cypresses of the neighbourhood, towards the end of the year 1879.

The insect has some resemblance in form to *Lachnus juniperi*, but it certainly is quite distinct from it, and the species has not been described before.

Note.—There has been an unavoidable error in the order of the plates, occasioned by the fact that the early plate was completed before the new *Aphis* was described. *Lachnus cupressi* should come after *Lachnus juniperi*, and before *Stomaphis quercūs*.

LACHNUS AGILIS, Kalt. Plate XCVI, figs. 3—5.

Aphis agilis, Walk.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·070 × 0·025	1·770 × 0·620.
Length of antennæ	0·035	0·880.
Cornicles wartlike.		

Fusiform, pilose, green, speckled with numerous minute reddish dots. Vertex and cauda tufted with bristles. Head broad. Eyes brown. Antennæ green. Legs green and very long. Tarsi distinctly two-jointed. Cornicles very small, almost invisible. Rostrum reaches to the first abdominal ring. Taken in June when they contained many embryos.

Pupa.

Linear, bright green. Head, eyes, antennæ, wing-cases, and legs smoky black. Rostrum reaches to the third coxæ only. These insects are very nimble in their movements, and to avoid observation run quickly between the pinules of the Scotch fir, *Abies sylvestris*, which tree they inhabit. They are

solitary in habit, being mostly found singly on the green fir tufts. Towards the end of June or the beginning of July they split their integuments and disclose the imagoes.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·200	5·08.
Size of body	0·070 × 0·025	1·77 × 0·62.
Length of antennæ	0·035	0·88.
Cornicles wartlike.		

Green, slightly mealy. Antennæ and eyes brown. Thorax pale reddish brown. Legs long, yellowish green, with dark femoral and tarsal tips. Wings relatively small. Stigmata long, and stigmatic veins continued in straight lines beyond the same. The furcal veins are often difficult to trace from their paleness of colour and tenuity. The vertex is tufted with capitate hairs; the rostrum is rather short, and reaches only to the third coxae. The apical rings are almost free from bristles, and rather attenuated. I suspect that Koch has in his figure 304 drawn an immature specimen of *Lachnus agilis* for *Lachnus pineti*.

Taken at Haslemere and Bramshot, Surrey, in June. Mr. Walker also forwarded me examples from Walthamstow. The winged forms are difficult to meet with.

LACHNUS MACROCEPHALUS, Buckton. Plate XCVII, figs. 1 and 2.

Lachnus hyalinus, Koch (?).

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·080 × 0·040	2·02 × 1·01.
„ antennæ	0·030	0·76.
Cornicles wartlike.		

Colour brown, ferruginous, or bright green; very pilose. Head very broad; vertex round. Eyes very large, pale red or brown. Antennæ rather more than one third the whole length of the body, pilose. No well-marked separation seen between the thoracic and abdominal segments. Abdomen with two double rows of black or brown punctures disposed longitudinally; single dots occur on the thorax. Body covered with a short woolly coat, particularly abundant towards the tail end. Legs stout and clumsy. Femora strong. Tarsi very long. Nectaries somewhat ferruginous. Apical rings obtuse and pilose, with ferruginous hairs. Rostrum short, only reaching to the third coxæ.

Pupa.

Very similar in colour to the above; bright green; head olive-brown. Eyes very large. Antennæ and legs furnished with ginger-coloured hair. Wing-cases brown.

Winged male.

	Inch.	Millimètres.
Expanse of wings	0·280	7·10.
Size of body	0·080 × 0·023	2·02 × 0·57.
Length of antennæ	0·035	0·88.
Rostrum	0·050	1·27.

Body linear. Head very broad; front convex and hairy. Antennæ remote at their insertions; the third joint equal to the four following joints taken together. Eyes bright red and large. Ocelli obvious. Head, pro-messo- and post-thorax rich brown. Thoracic lobes small. Abdomen shining green, long, and carinated, furnished with small tubercles, which are tufted. Whole insect sparsely covered with meal-like matter and short cotton-like filaments. Wings ample, with brownish iridescent membranes. Costa and stigma brown. Nervures very slender, brown; the second and third oblique veins much thicker than the others.

Rostrum very long, last joint hastate. Legs brown, and like the rest of the body, covered with ginger-brown hair. Tarsi long.

Several apterous specimens were sent to me from the spruce firs at Walthamstow late in June, and in July also I found this insect numerous at Bramshot on the same conifer, *Abies excelsa*. The winged males I bred in confinement; they emerged from their pupæ on July 26th. Like most of the Lachninæ they were very nimble and by no means easy to secure whilst hiding amidst the pinnules of the fir sprigs.

The apterous insect fairly agrees with the description given by Koch of his *L. hyalinus*; and his figure also fairly agrees with my insect. On the other hand, the winged form of *L. hyalinus* is described as rusty red, and as being very indistinct as to the third oblique veins on the upper wings. Koch's figure of the winged female differs very much from mine. I prefer, therefore, to mark *L. hyalinus* as a doubtful synonym.

This insect may be separated from *Lachnus agilis* by its less linear outline, its darker colour, its larger head, its greater hairiness, larger stigma, and more pronounced wing-veining.

I cannot say whether each species confines itself to one particular species of pine.

LACHNUS PINI, Linn., Plate XCVII, figs. 3, 4.

Aphis pini, Linn., Walk.

Lachnus pini, Kalt.

Aphis nuda pini, De Geer.

Pityaphis, Amyot.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·140 × 0·075	3·55 × 1·89.
Length of antennæ	0·065	1·64.
, cornicles	0·005	0·12.

Very large. Colour of various shades of brown, but usually of a dull brownish grey. Strongly pilose, particularly on the abdomen, which is soft and velvet like. Whole body finely punctured with dark brown dots. Dark patches occur on the front, the thorax, and the apical abdominal rings. Head large; eyes black and prominent. Antennæ fine, the third and fourth joints cinereous brown, the other joints black. Legs very stout and long, the hind pair particularly so. Colour pale drab with black femoral and tibial tips. Tarsi double-jointed and long. Cornicles obtuse and conical. Rostrum stout and about three quarters the length of the whole body. The whole insect is clothed with tawny hair.

Active in its habits, like the last two species, it rapidly threads the green pinnules of the Scotch fir, *Pinus sylvestris*, to avoid observation. It is solitary in its haunts, occurring sparsely on the older twigs, with the bark of which it assimilates so well in colour that it easily may be overlooked, except from the small tufts of cotton-like fibre that it attaches to the leaves.

Taken at Haslemere and at Southgate in June; but it appears to be rather restricted in locality.

Winged viviparous female.

This form is fully described by Kaltenbach and by Walker. It is reddish brown and covered with yellowish hair. The thoracic region is studded with black punctures.

De Geer makes some lengthy remarks on this Aphis under the name of *Aphis nuda pini*. The colour of the wingless forms is dependent on age. They occur occasionally of hues—yellowish, greenish, and reddish brown. Living specimens of these I have not met with.

LACHNUS PINICOLUS, *Kalt.*, Plate XCVIII.*Lachnus pinicola*, *Kalt.*, *Ratz.*, Pass.*Aphis pinicola*, *Walk.**Manducæ*

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·150 × 0·090	3·81 × 2·27.
Length of antennæ	0·070	1·77.
Cornicles very small.		

Large, oval, narrow towards the head, which last is rather broad. Antennæ stout. General colour of the body chocolate brown, with patches of grey glaucous bloom. Numerous large and small spots occur down the dorsum and the sides. First three antennal joints, the upper half of the rostrum, and all the legs, fine ochreous yellow. The tips of the rostrum, the antennæ, the lower halves of the femora and the tarsi, dark rich brown. Rostrum long and stout; it extends beyond the third coxæ or even longer. Eyes brown, as also are the very short cornicles.

The pupæ have orange-coloured bodies, with two rows of brown dorsal spots, and dark brown wing-cases.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·400	10·16.
Size of body	0·100 × 0·035	2·54 × 0·88.
Length of antennæ	0·060	1·52.

Smaller than the apterous female and not so robust. Head large and broad. Colour orange-brown. Thoracic lobes black. Abdomen brightly coloured, with a broad, undulating, brown dorsal stripe, ornamented with numerous white trapezoidal spaces. Two lateral brown stripes occur down the sides. Legs long, particularly the hinder pair. Antennæ and legs fine yellow, the last with black femoral and tibial tips.

Abdomen finely pilose. Wings very long ; insertions yellow ; cubitus brown, ending in a long and narrow brown stigma. Apical cell long oval.

Twenty-nine of these fine insects were bred from pupæ early in October, all of which formed the produce of one large apterous female. The young are, as usual, born tail foremost, and are enveloped in a fine membrane which, while the head of the young is still attached to the parent, is slowly worked off to the tail in wrinkles, and then cast off. The young are exceedingly active ; and even when adult, the insects, pupæ and all, run to the opposite sides of the branch of fir twigs on which they feed, to avoid observation.

This *Aphis* forms small clusters at the bases of the green tufts of the larch, *Pinus larix*, but usually it occurs in greater profusion on the Scotch fir, *Pinus sylvestris*, the bark of which assimilates very closely to the general colour of the insect, and thus conceals it.

The queen *Aphis*, or foundress, will live for a considerable time ; and will scarcely, unless alarmed, move from her place of feeding. I have marked a single specimen which was so located for three months. Her young ones, which possessed long rostra, migrated, but she remained fixed.

Lachnus piniculus is a prey to an *Aphidius*. Many examples may be found perforated by this parasite, with the curious flaps cut out of the skin of the *Aphis* erect, and attached by a sort of hinge to the hole. These *Aphides* are much sought after by ants.

Lachnus piniculus appears to be rare near Parma. Koch does not notice it in his Monograph. The tarsi are distinctly two-jointed, and this appears most markedly in the hind legs of the winged insect.

LACHNUS VIMINALIS, Fonsc., Plate XCIX.

Aphis viminalis, Boyer de Fonscolombe.
,, *salicis*, Shaw (?).

Aphis salicis, W. Curtis (?).

„ *saligna*, Walker.

Lachnus viminalis, Pass.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·160 × 0·120	4·06 × 3·05.
Length of antennæ	0·070	1·77.
„ cornicles	0·010	0·25.

Very large, globose, shining from a fine pile of silky grey hair. Colour dark ochreous brown. Head small, front flat. Antennæ short and slender, reddish at their bases but black at their tips. Two curved spots on the thorax. Abdomen very globose; centre of the dorsum furnished with a characteristic horn-like eminence. Cornicles large and obtuse. The dorsum has several rows of large transverse black spots. Cauda none. Legs long, particularly the hinder pair; pilose.

Pupa.

More elongated than the larva; colour very similar. Wing-cases sienna-brown, as also are the upper parts of the tibiæ. Dorsal tubercle large.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·600	15·24.
Size of body	0·180 × 0·070	4·56 × 1·77.
Length of antennæ	0·070	1·77.
„ cornicles	0·010	0·25.

Very large, general colour like the above insect. Head small. Antennæ very short and slender. Thorax robust. Abdomen oval, spotted with black, the largest spot being placed in the middle ring. This spot, which is covered by fine silky hair, seems to be the representative of the large tubercle pos-

sessed by the apterous female. Cornicles obtuse and very obvious. Rostrum reaches scarcely beyond the third coxae. Wings very long, and mostly carried horizontally when at rest, instead of pent-wise. Membrane rather coarse and hardly iridescent; insertions and cubitus orange-yellow; stigma very long, narrow, and brownish black. Veins fine and pale brown; first and second furcal nervures, soon after their origin, run nearly parallel. Costal nerve of the under wing nearly straight. Hind legs very long; all the tibiae ochreous red; tarsi distinctly biarticulate.

This *Aphis*, when crushed, yields a deep port-wine red stain, which is intensified by the action of an alkali.

I have no doubt that this insect is *Aphis saligna* of Walker, although he omits to notice the characteristic dorsal tubercle, or rather he calls it a large black spot, between the nectaries. Passerini remarks that Walker has erroneously written *Aphis saligna*, Sulz., for *A. salicis*, Sulz., and that the last *Aphis* is a species "omnino aliena."

Shaw, many years ago, in his 'General Zoology,' mentions, amongst others, *Aphis salicis*, and refers to Curtis's paper on *Aphis* in the sixth volume of the 'Linnæan Trans.,' where the insect is described as "nearly a quarter of an inch large, and one of the largest species," feeding on willow bark and not on the leaves. "Towards the end of September," he says, "multitudes of the full-grown insects, winged and otherwise, desert the willows on which they feed, and ramble over every neighbouring object in such a manner, that we can handle nothing in their vicinity without crushing some of them. Younger individuals still remain in large masses on the trees." He says they are yellowish grey, spotted with black, and that they stain the fingers red.

Sugar must have been difficult to procure in his day, we may suppose; for William Curtis says, "their secretion might be gathered and, by purification, converted into the choicest sugar or sugar-candy." Though

wasps feed greedily upon it, bees appear totally to disregard it.

The late Mr. Alfred Smee told me that an *Aphis*, which proved to be this *Lachnus*, swarmed in such thousands on his willows at Carshalton, that trees thirty or forty feet high had been killed by their poisonous influence.

I have received in June specimens from Carshalton and, through the kindness of Mr. Evershed, also from Shere, near Guildford. My friend Mr. James Salter found a cluster of them on one of his willow trees, near Basingstoke, five inches long, and an inch wide. The insects were ranged very closely together, side by side, with all their heads turned downwards, and on the lee side of the branch. The members of a swarm usually remain for a long time motionless, but if a single one is by any means disturbed it throws up its hinder legs with a jerk, in a tentative manner, and this movement is speedily communicated to all the individuals of the general mass. The action may be deterrent, to prevent parasitic attacks of *Hymenoptera*. I have attempted to represent this action in fig. 5, on Plate XCIX.

Several species of *Aphides* carry their wings horizontally when at rest, like the common house-fly, and some authors have considered this of generic importance. Although doubtless the position is exceptional amongst *Aphides*, too much value must not be placed upon the circumstance, for it may be seen in several *Pemphigniæ*, and also in *Thelaxes* (*Vacuna*, Heyd.). In *Lachnus viminalis* these two positions are indiscriminately adopted. The use of the conical tubercle on the dorsum is not certainly known. Although the apex is furnished with several minute pores, the organ may be regarded as blind or imperforate. It has not the function of a nectary, but probably that of an odorous gland.

It would appear that this *Aphis* has considerable facility of migration from spot to spot, and that this

journeying is practised by the wingless individuals *en masse*. Mr. James Salter observed that a large patch of these insects had collected on the bark of a willow, *Salix daphnoides*; they appeared to screen themselves from the rough and rainy south-west wind then blowing by retiring to the north-east side of the stem. Four days later the same tree was visited by him, but not a specimen could then be found by a most careful search. On turning to another willow, *Salix acuminata*, about five feet from the former tree, which certainly was not infested four days before, the missing patch was found. It is possible that this movement was caused through their previous disturbance and observation. If so, their march must have been very persevering and determined, for the intervening ground was covered by rank grass and weeds, ten or twelve inches high. Cold November weather set in a week later, and then not a single *Aphis* could be found in places where previously, in another part of the *salictum*, "myriads might have been collected without difficulty."

In Nottinghamshire this *Aphis* is sometimes very common. Its visits are intermittent, but I learn through a resident horticulturist that the harm they do to the trees is not at all marked. Mr. Smee's experience, however, would seem to be otherwise.

Mr. Salter sent me in the following March some thick willow stakes that had been infested during the previous year. The effects of their puncturing was conspicuous as brown stains disposed in stripes on the grey bark. I could, however, discover no trace of egg or hibernating female in the crevices, though assisted by a lens. Whether the insect descends to the earth for its winter shelter or not, is a question for a future observer to settle.

I believe that the *Lachnus dentatus* of Le Baron, of America, is identical with *Lachnus viminalis*, see 'Third Annual Report of Noxious Insects in Illinois,' by Dr. Cyrus Thomas, 1879, p. 116.

LACHNUS PICEÆ, Walk. Plate C.

Lachnus grossus, Kalt.*Aphis piceæ*, Panz.*Apterous viviparous female.*

	Inch.	Millimètres.
Size of body	0·190 \times 0·090	4·81 \times 2·27.
Length of antennæ	0·070	1·77.
Cornicles	wartlike.	

Very large, long oval. Head and thorax shining pitch black; the latter pitted with depressions. Eyes prominent, black. Antennæ very short and attenuated, black, the two last joints tuberculate. Abdomen smooth, domed, slightly carinated, colour dull sooty black, lustreless. The ring, fourth from the apex, covered with a cinereous mealy coat, which is continued to the under side. Cornicles very small. Cauda none, but the anal ring is garnished with brown hair. Legs pilose and very long, particularly the hind pair; colour rich sienna-brown, with black femoral and tibial points. Tarsi distinctly two-jointed. Rostrum very long, but it does not extend beyond the caudal end, black.

This is a large and handsome species. Numerous specimens were kindly sent to me in the month of October by Mr. Joseph Anderson, of Alresford, Hampshire, where he found them in the greatest profusion on the trunks and boughs of the spruce fir, *Abies excelsa*. A severe frost set in the evening after these insects were captured, and the next morning all had "vanished as if by magic." A few days afterwards sunny weather again set in, and the insects once more came out in full force. The sudden disappearance and the reappearance of this and other species is

remarkable, and difficult of explanation, for on one day trees may be black with them, and the next day none can be found, even by a careful search of the earth at the base of the trunks before infested.

The attacks of this species are often confined to particular trees, and in particular plots; sometimes a single spruce in the midst of others is alone infested.

Mr. Fitch, of Maldon, failed to obtain for me a single winged female; and I was unable to breed any from numerous apterous specimens he kindly forwarded, notwithstanding that I for some days kept them in confinement.

On the 28th of December of the same year, and from the same entomologist, I obtained some small fir-tufts of spruce which were covered with the black shining eggs of this same species. These ova were glued to the green pinules in rows, a drawing of which may be seen in Plate C.

Walker met this species in great abundance on the silver fir, *Abies picea*; and near London on the spruce. He took it also frequently on the firs of the Grimsel Alp, and it has been likewise found in Siberia. The winged insect has very large wings, and has a colouring very similar to the larval form above noted.

Kaltenbach describes *Aphis piceæ* of Panz., but he thinks that probably it is identical with *Lachnus piniculus*.

I have failed in precipitating the red dye formed by this and other *Lachniæ*, as a lake or a carmine compound: thus it does not imitate the behaviour of solutions of cochineal or madder.

LACHNUS LONGIPES, Dufour. Plate CI, fig. 1.

Aphis longipes, [Linn] Dufour.

„ *roboris*, Fonse.

Pterochlorus longipes, Rond. and Pass.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·170 \times 0·070	4·31 \times 1·77.
„ antennæ	0·080	2·02.
Cornicles wartlike.		

Long oval, uniformly deep brown. Antennæ very slender. Eyes black. Cornicles conical and small. Rostrum about equal the body. Apex hastate. Femora stout. Tibiæ curved. Cauda none. Abdominal apex setose.

The young are linear, with disproportionately long rostra and hind legs.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·720	18·20.
Size of body	0·180 \times 0·079	4·56 \times 1·99.
Length of antennæ	0·080	2·02.
„ cornicles	0·005	0·12.

This is one of the largest species comprised in the genus ; the winged form in expanse attaining to three quarters of an inch. Its general colour is of a rich brownish black. Abdomen large, oval, and glabrous. Antennæ short and slender, the third joint much tuberculate and as long as the fourth and following joints taken together. Eyes black. Cornicles conical, with large bases. Cauda none. Legs long, particularly the hind pair, very hairy, bright orange with black femoral and tibial joints. Tarsi double-jointed and black. Rostrum moderate, reaching to the third coxæ only. Wings very long and broad in the middle. Cubitus with broad yellow insertions, which end in long narrow stigmata ; these last attain to one third the length of the wing. The anterior costal nervures of both upper and under wings black, but all the other nervures are orange-yellow. Stigmatic vein nearly straight.

Taken plentifully late in December by F. Fitch, Esq., on exposed oak stumps at Maldon, Essex. Though so numerous, no apterous forms could then be found, probably they were preparing to give birth to the perfect sexes, which would furnish the eggs for the next year's progeny.

This insect is not very unlike the winged form of *Lachnus piceæ*, but it is much larger. The food of the two insects is different. It has considerable resemblance to the fine American species described by Prof. T. Monell, of the Missouri Botanical Gardens, St. Louis, and which he names *Lachnus longistigma*. This last insect has, however, the stigma continued round the greater part of the stigmatic cell, as a brown border, which certainly is not seen in the British insect.

Passerini in his diagnosis of *Pterochlorus longipes*, says, "Alæ stigmate trapezoideo," which hardly agrees with the insects I have seen. He also says that *L. longipes* affects the sweet chestnut *Castanea vesca*, as well as *Quercus robur* and other kinds of oak. He gives a caution that it is not to be confounded with *Aphis roboris* of Linnæus, which does not occur in Italy.

Dufour's description answers well to the above diagnosis, except as to the words "Alis maculis duabus magnis atris subfenestratis," which might possibly apply to the stigmata.

GENUS XXI.—STOMAPHIS,* Walker.

Head and eyes small. Antennæ slender, moderately long, six-jointed, third joint the longest, the sixth as long as or longer than either the fourth or fifth, the aborted seventh joint longer than in *Lachnus*. Cornicles very inconspicuous. Legs shorter than in *Lachnus*, and less stout. Tarsus biarticulate. Tail

* From στόμα, a mouth, and ἀφίσις.

none. Rostrum very long in the apterous females, but shorter in the winged forms. According to Walker altogether wanting in the males.* The four joints sometimes equal three times the whole length of the body. Setæ very long and convoluted.

Wings very short, a little longer than the body (Walker), and carried horizontally (Réaumur†). Stigmata rhomboidal. Stigmatic vein curved (Kalt.).

STOMAPHIS QUERCUS, Réaum. Plate CI, figs. 2—5.

Puceron de Chêne, Réaum., Bonnet.

Aphis quercus, Linn., Walk.

„ *longirostris*, Fabr. (?).

Lachnus quercus, Kalt., Walk., Pass.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·210 × 0·080	5·33.
Length of antennæ	0·100	2·54.
„ rostrum	0·570	14·44.

Very large, shining brown, rather hairy, oblong. Head small. Eyes brown. Legs moderately long and fine. Antennæ slender; about half the length of the body; brown, except the third joint, which, like the femoral and upper tibial portions, is ochreous yellow. Rostrum very long and trailed between the legs whilst walking, so that this protruding organ appears like a long tail. Cauda wanting.

Found, from July to October, on the stems of the oak, into the bark of which the insects thrust their rostra so deeply that they can be removed with difficulty. The antennæ are usually rapidly vibrated, somewhat in the manner seen in the *Ichneumonidæ*,

* Mr. Walker thought that there were sufficient structural differences in this *Aphis* to separate it from *Lachnus*. Although he did not publish any generic characters, he suggested the above name, which I have gladly adopted. *Vide* 'Cat. Hom. Insects,' part iv, p. 961.

† Réaumur, 'Mém. des Insect.' iii, 334, pl. xxviii.

and this action is continued during the visits of the black ant, *Formica fuliginosa*, which by trooping up and down the branches of the trees often betrays the presence of the *Aphis*. The winged form appears to be exceedingly rare. Neither Walker, Passerini, nor myself have ever met with a living specimen. Kaltenbach, however, describes it, and he notices that there are winged and apterous males, both of which are of diminutive size.

This *Aphis* is very scarce in England, but at one time it seems to have been somewhat common in France and Germany. It has been described with some particularity by Réaumur* and Bonnet, and afterwards by Kaltenbach. It is not, however, included in Koch's list of *Lachninae*.

Mr. Walker communicated to me the following note on this insect in answer to my inquiries :

"I think Tugall was the first person to discover *Aphis quercus* in England, and he mentioned it to Stephens, who published a notice thereon about 1847 ; but I do not find it mentioned in the list of writings of the latter author. About that time Tugall directed me to an oak near Dulwich, where I found it ; and some years after, the late Mr. Alfred Smee told me of an oak at Weybridge, where I found it again, and subsequently I met with it at Finchley. I have only named, not described it, as *Stomaphis*, though I think that it is sufficiently peculiar to be separated from *Lachnus*. The male is mouthless, or rather it has no rostrum."

Bonnet describes an *Aphis* which I think must be referred to the above insect. He says it is remarkable for the magnitude of its trunk. "Le puceron de chêne—c'est l'éléphant des pucerons," and as large as an ordinary fly. It attaches itself to the branches of the oak, which "on commence à noircir." La couleur "brun foncé terne sur le dos, peu luisant sous le ventre ;" legs, antennæ, and trunk, "rouge maron."

* 'Mém. des Insectes,' ix, p. 334, tom. iii, 1734.

Length of the trunk about twice that of the body. They occur winged and apterous, but the former are less common. "The wings are carried perpendicularly, like those of a butterfly." The insects have an "odeur assez forte." Other authors do not seem to have noticed this character. Bonnet thinks this long trunk is used for probing the crevices of the bark as well as for suction.

He also discovered the apterous male; he gives a ludicrous account of the insect's antics during courtship, and he states that both antennæ and legs are rapidly vibrated at the same time.

Passerini remarks that *Lachnus longirostris* is diverse from *Lachnus quercūs*. The food certainly is different, for the former insect feeds on the willow and the poplar, instead of on the oak.

Linnæus probably describes this insect under the name of *Aphis quercūs*. He gives for characters, "Pro-boscide longissimâ, habitat in corticibus quercūs in Galliâ. Maxima nostratum atra, alæ hyalinæ margine externis atro, antennarum pedumque articuli basi ferruginei. Rostrum longitudine abdominis. Abdomen muticum.

GENUS XXII.—PARACLETUS,* Heyden.

Rostrum variable in length, but shorter than in *Trama*.

Antennæ six-jointed, with a nail at the extremity of the sixth; third, fourth, and fifth joints nearly equal.

Cornicles: none.

Legs long; tarsi biarticulate; claws two.

Eyes moderately developed. In this particular it differs from *Trama*.

* From παράκλητος, a consoler; probably referring to these insects being cherished guests in the nests of ants.

Winged forms unknown.*

Réaumur, more than one hundred years ago, found Aphides in ants' nests ; but Von Heyden was the first to assign genera for these insects. *Paracletus*, *Forda*, and *Trama* comprise some minute species which, so far as observation yet goes, are apterous and subterranean in habit. Burmeister subsequently added *Rhizobius*, which expresses an underground habit ; and Passerini has found it convenient to class these several genera together under the section *Rhizobiinæ*, an arrangement which for the present may be considered good. Some name must be found for tribes or sections, and it is difficult to avoid meanings too distinctive in such names—distinctions which further research might render it necessary to qualify.

Root-feeding Aphides are now known to obtain in many dissimilar genera, such as *Siphonophora*, *Aphis*, *Schizoneura*, *Pemphigus*, and *Phylloxera*. It would, therefore, seem to be desirable that all comprehensive tribes should have some trivial name which shall not be too exclusive on the one hand, or unmeaning on the other.

It has long been a problem to solve what habit and condition are assumed by those Aphides which appear to be restricted to short-lived annual plants for their sustenance. When such plants die and become rotten, what becomes of the insects during the eight months when no food seems fitted for their use ? Three hypotheses may be advanced to meet this difficulty.

1st. Immediate descent into the soil, attended by subterranean oviposition.

2nd. Migration of the imperfect females to plants of other species, followed by complete development of the cycle upon that plant.

3rd. Dimorphism, amounting, perhaps, in some cases, to the passage into more complex forms, hitherto regarded as stable species in the ordinary sense of the term.

* Walker's description, if such, appears to me too vague to allow of identification. *Vide 'Cat. Homop.'*, vol. iv, p. 1062.

Hypothesis No. 1 has the great disadvantage that the young brood when hatched must be generally too far removed from their natural food to make it probable that they would ever meet it. The ova also would remain many months under ground during the autumn, perhaps without development.

No 2.—Migration to other plants certainly takes place in several instances. Walker asserts it, with considerable probability of the hop *Aphis*, whilst the omnivorous character of the bean and the plum *Aphis*, and also that of the wheat is very clear. Lichtenstein states the same habit is assumed by *Dryobius* and *Schizoneura*.

No. 3.—Dimorphism, with great change of economy, has been conclusively proved in the vine pest, *Phylloxera vastatrix*; and there seems little reason for doubt that persevering workers will prove a similar habit in other genera.

Thus, we may expect that some root-feeding Aphides will be proved to be dimorphs of some well-known aerial species; and conversely, that others hitherto supposed to be strictly aerial, whose existence has now been traced only to two or three months' duration, will eventually be referred to subterranean feeders with other specific names.

These remarks are made as introductory to two genera which are in a sense exceptional; inasmuch as some characters would ally them to the *Lachninae*, and others to the *Aphidinae*. Koch places *Trama* low in the scale, even after *Pemphigus*. Passerini places *Trama* and *Paracletus* amongst the *Aphidinae*. If these species should ever prove to assume wings, I think it probable they will show the venation of *Lachnus*. The character of their antennæ and large development of their rostra better also accord with *Lachnus* than with *Pemphigus*, and therefore I here place them in sequence.

PARACLETUS CIMICIFORMIS, Heyd., Plate CII, fig. 4.
Kalt., Pass.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·080 × 0·040	2·02 × 1·01.
Length of antennæ	0·040	1·01.

Oval, flat, somewhat shining; colour wax-yellow, naked. Head rounded, with a furcate mark on the vertex. Eyes small, but obvious. Antennæ six-jointed, hairy, yellowish, and about half the length of the body. Abdomen carinated and garnished with rows of small dots.

This Aphis does not appear to be plentiful anywhere. It has mostly been taken in the nests of *Formica rufa*, and then usually in company with another underground Aphis, *Forda formicaria*.

It has somewhat the appearance of the bed-bug, whence its name, but it is active in its movements, and runs quickly. Kaltenbach found about fifty of them, in the month of April, in one nest, where he considered that they had passed the winter in friendly relations with the ants.

Passerini found them on the roots of *Festuca duriuscula*. Like Kaltenbach, he notices that the winged form is unknown; but Walker describes the veining of the wing of an example that he appears to have met with. Unfortunately, he does not even say if the cubital vein is twice or only once forked. His description, indeed, leaves it doubtful whether his insect was a *Schizoneura*, a *Lachnus*, or other genus.*

* Walker's 'Cat. Homop. in the British Museum,' vol. iv, p. 1062.

GENUS XXIII.—TRAMA,* Heyden.

WURZELLAUS. ROOT-APHIS.

Rostrum large, at least two thirds of the length of the body. Much longer in the young.

Antennæ about half the length of the body, six-jointed, excluding the apical unciform process; third joint the longest, and about equal to the fourth and fifth taken together. Fifth and sixth joints equal.

Cornicles none, or mere pores.

Legs long, particularly the hind pair, which possesses only one long tarsal joint, which equals the femur in length. The other tarsi two-jointed. Claws two.

Tail inconspicuous.

Eyes very small; almost obsolete.

The winged form has never been described, and its existence was unknown to Heyden, Kaltenbach, and Passerini. On the other hand, Walker says that the insect "occasionally, but very rarely, acquires wings," but he gives no authority for the fact.†

Kaltenbach describes *Trama* in one place as having seven antennal joints, but in another only six. The process at the end of the sixth joint appears to me to have no greater claim to be regarded as an articulation than that seen in *Lachnus*, which is quite as much developed.

TRAMA TROGLODYTES, Heyden. Plate CII, figs. 5—7.

Walk., Pass.

Trama radicis, Kalt., Koch.

„ *pubescens*, Koch.

„ *flavescens*, Koch.

Aphis radicum, Goureau.

Rhizobius helianthemi, Westw.

* Derivation doubtful.

† Walker, *op. cit.*, p. 1061.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·115 × 0·060	2·92 × 1·52.
Length of antennæ	0·065	1·64.

Body long oval, slightly domed, ringed and carinated, hairy. Colour greenish or yellowish white, transparent. Head rather small; eyes almost rudimentary. Antennæ about half the length of the body, six-jointed, the last being provided with a nail. Rostrum long, but the length varies with age. In young examples it projects beyond the abdominal apex. Legs long, particularly the hind pair, which have largely developed tarsi, furnished with a double claw. By these tarsi the insect may be readily separated from all other described root-feeders. The long hind legs are often vibrated, and occasionally they are jerked upwards in the manner affected by several *Lachninae*.

When the insects are unearthed they appear of a pale semitransparent hue, but by exposure to the air the antennæ and legs speedily become browner.

Trama troglodytes feeds on a variety of roots. Amongst these may be named *Leontodon taraxacum*, *Cnicus arvensis*, *Sonchus oleraceus*, *Lactuca sativa*, *Hieracium pilosella*, *Crepis biennis*, and *Artemisia vulgaris*.

Heyden found small companies of this species domiciled in ants' nests; and Sir John Lubbock, from Beckenham, and Mr. Hardy, from the Grampian Hills, have obligingly forwarded examples to me taken from similar localities.

The part played by these Aphides in the economy of these ants is not very obvious. Their presence can scarcely be for affording food to their hosts, for the absence of nectaries seems to preclude the secretion of the nutritive honey-dew. Such an explanation, moreover, will not account for the like presence of various

remarkable blind beetles, onisci, and centipedes, which are also the known denizens of ants' nests.

These apterous Aphides may be taken in such situations till late in November, and probably there they hibernate. *Aphis radicum*, Goureaux, is referred to *Trama* by Boisduval. *Trama troglodytes* is frequent on the high moors in Berwickshire, and mostly located in the nests of *Myrmica rubra* or *Formica fuliginosa*.

GENUS XXIV.—DRYOBIUS,* Koch.

KNOPPERLÄUSE. CLOUDED OAK-APHIS.

Rostrum rather long and thick, projecting beyond the post-sternum. Much longer in the young.

Antennæ slender, six-jointed, with an unciform process on the sixth joint. Third joint more than twice the length of any other. The fourth and fifth joints about equal. The sixth less than half the length of the fifth.

Cornicles conical, and very short.

Cauda inconspicuous and rounded.

Legs, the first two pair moderately long, the hinder pair disproportionately long; tarsus composed of two distinct joints.

Wings moderately long in the males, but very short in the viviparous females. Stigmata rather long. Cubital and first furcal veins issue from the same point, which is at some distance from the cubitus. The membrane of the upper wings variegated with brown smoky fasciæ.

* From ὄρυξ, an oak, and βιοω, to live. Prof. Monell warns me that there is an American lepidopterous insect named *Dryobius sexfasciatus*. I have failed to learn anything definite about this insect, or whether *Dryobius* can claim priority as a lepidopterous form over that genus as an *Aphis*. Koch's commenced to publish in 1854. Mr. McLachlan informs me that *Dryobius* is a coleopterous genus which approximates to the above name. In this uncertainty I retain Koch's nomenclature.

N.B.—It may be noted that in some Aphides the rostrum attains its full development and length at the early stages of life. There seems afterwards to be an arrest of growth. In some genera to follow, this organ in the young projects far beyond the end of their bodies, whilst in the mature forms the proboscis hardly attains to the third coxa.

DRYOBIAUS ROBORIS, Linn. Plate CIII.

Aphis roboris, Linn., Fonsc.

Lachnus fasciatus, Burm (?).

Cinara roboris, Curtis, Sir O. Mosley.

Lachnus roboris, Kalt.

Dryaphis, Amyott.

Dryobius roboris, Koch.

Apterous oviparous female.

	Inches.	Millimètres.
Size of body	0·150 \times 0·090	3·81 \times 2·27.
Length of antennæ	0·070	1·77.
„ cornicles	0·010	0·25.
„ rostrum	0·060	1·52.

Oval, anterior portion produced. Head and thoracic segments narrow. Abdomen broad across the cornicles. Colour shining reddish brown. Head, thorax, and last abdominal ring blotched with black. Cornicles very small, dark, and rising from circular black patches from the sixth abdominal segment. Antennæ slender, orange-brown with black tips. Legs shining orange with black tarsi, and black femoral and tibial points; tarsi with two distinct joints; hind legs very long. Rostrum reaches beyond the third coxae.

Apterous ♀ oviparous female.

This has very much the appearance of the last insect. Koch says it much resembles the female of

Lachnus pini, except that it has no downy coat, and that its hind legs are very much longer.

Winged male.

	Inch.	Millimètres.
Expanse of wings	0·340	8·62.
Size of body	0·110 \times 0·040	2·80 \times 1·01.
Length of antennæ	0·060	1·52.
, rostrum	0·070	1·77.
Cornicles mere warts.		

Body much slimmer than that of the female. Head and thorax disproportionately developed, whilst the abdomen is of small dimensions. Uniform colour shining brown, with the exception of the prothorax or neck-ring, which is of a reddish pitchy tint. Thoracic lobes long and large. Antennæ, about half the length of the body, brown. Legs shining orange-brown, with black femoral, tibial, and tarsal points. The abdomen and legs are densely clothed with yellow hair. Wings long and narrow; membrane rather fuscous, except as regards the stigmatic cell, which is clear and hyaline. Stigmata ochreous, cubitus brown and stout, the other veins dark brown. The first furcal nervure joins the cubital nervure almost at its extremity, and these veins do not quite touch the cubitus. All the veins of the upper wing shade off into broad brown cloudy stains, which extend throughout their entire lengths. All the cells are prettily clouded at their basal margins, but this variegation differs from that seen in *D. Croaticus*. The lower wings are not clouded.

A gentle pressure on the abdomen causes the protrusion of a very large hooked penis. The curious anatomy of this organ will be noticed in the section devoted to the description of the reproductive apparatus of Aphides.

Towards the middle of November M. T. Lichten-

stein forwarded to me numerous specimens of the oviparous female from Montpellier. They were taken on the branches of *Quercus robur*, upon the bark of which they had deposited numerous brown eggs, *vide* Plate CIV, fig. 6. This nidus for the eggs is different from that chosen by *D. Croaticus*, which deposits in Southern France on the upper surface of the leaf of the evergreen oak, *Quercus ilex*, as seen in Plate CIII, fig. 5. M. Lichtenstein remarks "how wise of this insect to know that the leaves of the ordinary oak will fall! and therefore it chooses the bark."*

The oviparous female drawn in Pl. CIII was taken from a live specimen bred with others at Montpellier. It agrees well with Kaltenbach's and Koch's descriptions. As, however, the perfect female had not before been figured, I thought an example, though a foreign one, would not be without its value to the entomologist. Koch found masses of similar eggs disposed much like those of the lackey-moth, *Gastropacha neustria*. A crust composed of perhaps one thousand encircled a bough of oak. This mass was about an inch broad, and probably was the produce of several oviparous females.

In Germany the acorns seem to be attacked as well as the soft stalks. According to Koch the stalked oak, *Quercus pedunculata*, is preferred by *D. roboris*.

In the species described by Bonnet, and which is probably identical with the above, he states there are both apterous and alate males. Such may be the case, but the observation requires confirmation by others, though this phenomenon certainly occurs in other genera of Aphides.

Kaltenbach and Walker both include *Lachnus fasciatus* of Burmeister in their synonyms of *L. roboris*. The former author states that he captured specimens of *L. roboris* on *Pinus sylvestris* and *P. abies*. I think

* As *Quercus ilex* is not a tree indigenous to Britain it is probable that the choice of nidus differs in the two countries. I am not able to state from personal observation the precise locale affected by the English insects.

it probable that he mistook this insect for *Lachnus fasciatus*. As I consider this last to be of a different species, I altogether exclude it from the synonyms above written.

The reader is referred to a paper by M. Lichtenstein,* in which he says that he watched the manœuvres of eight males, which discovered several captive females through some instinct which he could not explain. These males eventually coupled with about one hundred females, which soon disposed themselves to lay their eggs. These eggs formed a crust of great regularity, and were covered by a brilliant black varnish. Sometimes they have also, he remarks, a covering of downy matter. The eggs bear with impunity a temperature of 12° or 15° below zero Centigrade.

Thus, unlike most insects, polygamy is practised by the males of *Aphis*. M. Lichtenstein tells me that he has often seen the winged males waiting for the females which gather on the same tree, which, after fecundation, place their eggs in a wonderful order on the same branch. In the case of *Dryobius roboris* "a branch may be covered for a foot or more."

DRYOBIA CROATICUS, Koch. Plate CIV.

Aphis roboris, Walk.

Apterus viriparous female.

	Inch.	Millimètres.
Size of body	0·150 × 0·080	3·81 × 2·02.
Length of antennæ	0·070	1·77.
„ cornicles	0·010	0·25.
„ rostrum	0·100	2·54.

Very large. Head and thorax rather narrow. Abdomen broad across the nectaries. General colour isabel-brown, passing into a redder shade; head

* 'Bull. Soc. Ent. de France' (5), iv, pp. 241, 242.

blackish, prothorax usually with two small black patches succeeded on the meso-thorax by a crescentic spot. Cornicles conical and black, rising from two circular dark spots. Cauda rounded and short. Legs long, particularly the hinder pair; foxy yellow with dark femoral and tibial joints. Tarsi biarticulate. Antennæ slender, orange-coloured tipped with black. Rostrum stout, and about two thirds the length of the body.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·400	10·16.
Size of body	0·210 \times 0·080	5·33 \times 2·02.
Length of antennæ	0·080	2·02.
, cornicles	0·010	0·25.
, rostrum	0·060	1·52.

Body rather larger and more oval than that of the apterous female. Head small. Thorax very large. Abdomen oval. Colour much like the preceding insect, dullish brown with darker thoracic lobes. Nectaries small and conical, rising from black patches. Cauda obtuse. Anterior and medial pairs of legs moderately long, but posterior pair disproportionately so. Colour same as with the apterous female. Antennæ orange-yellow, tipped with black; pilose. Wings relatively short, rounded at the tips; insertions yellowish; cubitus and stigmata brown. The first furcal and the cubital veins take their origin from the same point, and do not anastomose from the cubitus. Membrane hyaline, and handsomely brocaded with rich brown, the colour being caused by a dense net-work of faintly pigmented hexagonal cells like those of a honey-comb. The whole of the first discoidal and the first cubital cells are thus covered; and also parts of the second discoidal, the second cubital, and the marginal cells. A brown blotch on the stigma is carried into part of the infra-marginal cell. The margin of the wing has several ornamental indentures of the uncoloured mem-

brane. All the nervures themselves are dark brown. The lower wings are unclouded.

This pretty insect is one of the largest of the family of *Aphis*, and is diffused over a large area of the Old World. It was found by Dr. Rosenhaur inhabiting the oaks of Croatia, whence its name. It is also found far north in Sweden, and has been discovered in Central Asia in the district of the Amur (Walker). As it does not appear in Passerini's list, perhaps it is confined to the cold and the more temperate regions of the south.

This insect is not uncommon in several parts of England. The examples figured were kindly sent to me by the Rev. N. Andrews. He obtained them by climbing the branches of an oak at Southwater, near Horsham. They are usually stated to prefer the branches springing from old oak stumps. The ants *Formica rubra* and *F. fuliginosa* seem greatly to relish the juice excreted from their nectaries. Late in November I received a consignment of these Aphides from Montpellier, and also a leaf of the evergreen oak *Quercus ilex*, on the upper surface of which some hundreds of dark brown eggs had been deposited,—the produce of several females, five of whose dead bodies were still attached to the patch of ova.

The eggs, which are not strictly oval in form, but inflected on one side, were laid very closely together, mostly in parallel rows. They were covered with a glutinous substance which was insoluble in water, for they could not be detached by a camel-hair brush filled with water. This covering seems to continue moist, since it entangles particles of foreign matter which float in the air, and thus perhaps an artificial protective coat is formed. M. Lichtenstein notices these different locations of the ova in *D. roboris* and *D. Croaticus*, and considers the circumstance as confirmatory evidence of the insects being specifically different.

From specimens mounted by Mr. Walker—I believe

that the insects named by him *D. roboris* are really *D. Croaticus* of Koch. But Mr. Walker's description in the 'Ann. of Nat. History' is very obscure, and the sense of the latter part involved. Koch does not appear to make any very marked distinctions in his diagnosis between the two species, but they amount to this, that the insects differ in their general tones of red, and the form of brocading on their wings. He states that his description and figure of *D. Croaticus* is borrowed, but he does not say from whom. He notes that the eggs of *D. roboris* are deposited on twigs, peduncles of leaves, and on fruit capsules ("Trieben, Blattstielen, Fruchtkapseln").

The tinctorial character of some Aphides has been before noticed. The English specimens of *D. Croaticus*, in a very marked degree, stain Canada balsam, disulphide of carbon, alcohol, &c., of a fine port-wine red. I do not notice this peculiarity in the examples of *D. roboris* sent me by M. Lichtenstein.

Lichtenstein adds another reason for believing *D. roboris* and *Croaticus* distinct, viz. that the males vary as to their wings, and that the sexual forms of the former appear about a fortnight later in the autumn than the latter.

In France the egg of *D. Croaticus* laid on *Quercus ilex* hatches in April, and the mother Aphid produces young which assume wings and then they migrate, but to what tree it does not appear. Lichtenstein thinks they go to *Quercus robur* and *Q. pubescens*, and that they eventually come back again to the *ilex*.

In countries like England, where *Quercus ilex* is not indigenous, we must suppose there is some modification both of food plant and nidus, for oviposition.

The genus *Dryobius* does not appear to be represented in America by any described species. Wherever the common Oaks of the old world, *Quercus robur*, *Q. pedunculata*, and *Q. sessiliflora* are found, the Aphides peculiar to these trees may pretty generally be met with. Although these trees extend over the whole of

Europe, except the extreme north, penetrating along the chain of the Caucasus a considerable way into Central Asia, they seem only to occur in America through an artificial introduction. Probably the isolating action of the two great oceans which wash the shores of this continent has prevented the migration of these fragile insects. Numerous Aphides, however, there occur on the Oaks peculiar to the States of America.

Before concluding these remarks, I will notice an *Aphis* which Mr. Walker preserved in Canada balsam, and afterwards presented to me. He named it *Aphis cistata*, but I believe he never described it.

The winged form is the only one I have seen, and therefore I cannot furnish figures. The insect has many of the characters of *Dryobius*.

Dryobius cistatus, Walk.

	Inch.	Millimètres.
Expanse of wings	0·380	9·64
Size of body	0·130×0·040	3·30×1·01
Length of antennæ	0·050	1·27

Thorax broad; abdomen large and oval; cornicles inconspicuous. Head rather small; antennæ short, the third joint the longest, the three following joints about equal. Legs and wings rather short. Cubitus stout, ending in a large clouded stigma; cubital vein very slender, the first furcation very fine, and the second very difficult to distinguish. The first and second oblique veins very thick; the membrane across these veins is slightly clouded with brown.

Taken at Southgate, late in June, on the Spruce-fir. The insect is not to be confounded with *Aphis costata*, Walk., which would appear to be a *Callipterus*.

II.

SECTION.

SCHIZONEURINÆ* PASS.

UPPER WING WITH CUBITAL VEIN ONCE FORKED.

LOWER WING WITH TWO OBLIQUE VEINS.

ANTENNÆ  SEX-ARTICULATE.

* From $\sigma\chiι\zeta\omega$, to cut, and $\nu\epsilon\nu\rho\nu$, a nerve

SCHIZONEURINÆ.

This tribal division was made by Passerini, who thought that, as certain insects showed a more complex wing venation than others, they should be grouped separately.

The cubital vein, which is but once forked, takes its rise from a point at some distance from the cubitus, whence the origin of the name.

INTRODUCTORY.

The insects comprised in the two following tribal groups have many characters in common. Their wing-neuration, ringed form of antennæ, and life-history, seem naturally to separate them from the foregoing Aphidinæ.

As a general rule, these insects either roll the leaves of trees, or build up gall-like structures on their surfaces, or otherwise by modifications of their foot-stalks, construct habitations for concealment. These masses are often of considerable size, and by their diversity of shape afford material help towards the identification of the species which make them.

C. J. Geoffroy seems to have been the first author who drew attention to such galls. In 1724 he compared examples, and described them as tenanted by thousands of pucerons.

Subsequently Réaumur figured roughly, but with considerable spirit, several kinds of these galls. He says of those on the elm tree :—“ Il-y-a des années où elles deviennent communément plus grosses que des noix, et où on trouve de monstrueuses qui approchent de la grosseur du poing.” He says that each of these constructions is the work of one single *Aphis*, which becomes encircled by the “bottle-like” walls of vegetable growth.

Von Gleichen also commented on these pseudo-galls, and later Haliday, in the ‘Ann. Nat. Hist.’ for November, 1838, made some interesting observations on the habits of certain species which he comprised in his new genus *Eriosoma*. The majority of those named by him are gall-makers. A very similar arrangement was proposed by Leach. It corresponds with Latreille’s third group of *Aphides*, amongst which De Geer figured *Aphis gallarum ulmi*, *A. tremulae*, *A. xylostei*, and less correctly placed, *Aphis gallarum abietis*, which is more nearly allied to *Coccus*, and is now known as *Chermes abietis*.

Before Passerini's time the number of ascertained species was not large, but he increased the list of genera, and described, in 1863, twenty-one species inhabiting Italy alone.

Until quite recently our knowledge of the life-history of this group was very incomplete, but within these last ten years, through the labours of Lichtenstein, Riley, Löw, Monell, Courchet, and Kessler, a large mass of information has been accumulated, memoirs have been written, and excellent drawings made. For those who wish to follow the metamorphoses of these insects closely, I have, at the end of the diagnosis of species, added a list of memoirs in the order of their appearance. Where so many have worked, it is not easy to decide upon priority in discovery, and indeed many important points have been discovered simultaneously in different countries.

The remarkable phases assumed by *Phylloxera*, first made known by Planchon and Lichtenstein, have suggested a somewhat similar economy in these higher groups. Very little was known of the mode of existence of the winged forms of the *Schizoneurinae*, which issue by thousands from the galls above alluded to; and nothing was known of the egg, or the true sexes, or whether hibernation took place; or if the constructor of the gall survived the winter, or was hatched in spring from the presumed egg. A great deal of this uncertainty has now been cleared away. Professor Charles Riley, in America, has proved that all the elm-inhabiting *Pemphiginae* west of the Mississippi give rise to perfect sexes in the autumn, and that the impregnated egg is consigned by the female to some sheltered portion of the trunk, where it rests secure till the following spring. The issue from this egg constitutes the stem mother (the *Pseudogyne fundatrice*) of Lichtenstein, and she is the constructor of the gall, just as a *Schizoneura* mother commences the rolling of the leaf as a protection to her future progeny.

Professor Riley claims to have made the discovery in

1875, that in *Sch. americana* wingless and mouthless males are produced. Again, M. Jules Lichtenstein has distinctly proved that the perfect sexes are the produce of that second series of the winged generation which left the galls for the purpose of dropping their young in the bark fissures. These sexes soon pair, and at once commence the process of oviposition of their single large egg.

Dr. H. F. Kessler, of Cassel, through many experiments and observations, showed also that the females of the *Pemphiginae* affecting the leaves of *Ulmus campestris* retired to the trunk in the winter to oviposit, and that speedily afterwards they died.

In 1878, M. Lucien Courchet, of Montpellier, gave an excellent general *résumé* of the *Aphis* group, and towards the end of his memoir he fully went into the description of "les Pucerons du térébinthe et du lentisque." The following year he published his 'Étude sur les Galles produites par les Aphidien.' These observations extend over more than one hundred pages. The memoirs are embellished by six well-executed plates, showing the structure of the galls, and furnishing various details relating to the antennæ and the wing-veining of the *Pemphiginae* inhabiting these galls.

M. Lichtenstein has patiently and successfully traced some of these *Aphides* through their various stages of development. He has employed a nomenclature to distinguish the seven buddings or pseudo-births which here it may be interesting to notice.

The immediate issue from the egg he styles *Pseudogynē** *fondatrice*. To all the generations except the final he gives the name of *Pseudogynes*, but to the third series, which is winged, he gives the name of *Pseudogynes emigrantes*. The progeny of these last insects is apterous, and he styles them *Pseudogynes bourgeonnantes*. The sixth generation is also winged.

* *Pseudogynē*, from $\psi\epsilon\nu\delta\alpha\zeta$, false, and $\gamma\nu\nu\gamma$, female. The former terms, *Androphore* and *Gynephore*, have been relinquished by him.

The individuals are usually smaller than those of the previous generation (No. 3), and seem already to have commenced a degradation of form. The insects transport themselves from their previous habitats, and carry within them the embryos of the true sexes. To these winged forms Lichtenstein gives the name of "*Pseudogynes pupifères*."

The last generation consists of males and females, both of which are exceedingly small. This circumstance probably is the cause of their being so long overlooked by early observers. The males are usually apterous. Amongst the higher Aphides this sex is very active and completely organised, but here the insects are very simple in structure; and from the fact that their mouth organs are simply represented by buccal prominences, which appear to be imperforate, they must be quite incapable of feeding. The antennæ also are restricted in the number of their joints, which would indicate, perhaps, a bluntness of sense as furnished by those organs.

The oviparous female is also, in many cases at least, mouthless. The abdominal cavity shows only rudiments of an alimentary system, and, indeed, it is almost wholly occupied by the single ovum, which is not much smaller than the insect itself.

Shortly after impregnation, the female retires to some chink or crevice under the bark, and there she dies, often without delivering herself of her egg. In this case the exuviae form a natural covering to the egg, the dead body of the parent furnishing a nest for her unhatched young. Sometimes the ovum is found covered by the cotton-like down spun by the mother, but in this case oviposition clearly has occurred.

The diversity of form and colour shown in these galls is remarkable; yet it will not be safe to infer that because a gall is constructed on a different portion of a leaf, or is diverse in form or colour, that it necessarily proves to be the work of another insect. Nevertheless, there is often a distinctive character of nidus-

construction effected by various species, which greatly helps the student in separating kinds, the diagnosis of which is obscure. This assistance also may be claimed in distinguishing the *Schizoneurinæ*.

Thus we have all varieties of form, from the simple folding of the leaf to the open bladder-like blistering of the surface, and from the pedunculated gall and the large hollow purse of *Schizoneura lanuginosa* to the complicated and fruit-like form constructed by *Chermes*, in which the excrescence exactly mimics the fir-cone with all its bracts.

The causes of these diversions of growth and modification of structures in the leaf into such remarkable adaption for a purpose, has engaged the attention of many. The subject is a large one and of high interest, but as it pertains more correctly to the science of vegetable Teratology, only passing allusions and remarks will be permissible in this Monograph.

It may be noted that the injection of acrid or other juices into living vegetable tissue by *Hemiptera* and other insects, produces in plants phenomena very similar to inflammation in animal organisms. Vessels become turgid, cell-walls become thickened, and abnormal growths (in vegetables often elegant instead of monstrous) take the place of simpler structures.

Some writers have thought that all insect galls are modifications of either fruit or leaf buds,* but many forms cannot satisfactorily be referred to the malformation of originally normal buds. The "mimicry" of fruit observable in some kinds is very remarkable, and these probably point to such an origin; amongst which, as an *Aphis* production, may be noticed the above-mentioned gall of *Chermes abietis*. It is only by cutting into such structures that we can distinguish their nature from a true fruit.

The oak galls, known as oak-spangles, the work of *Neuroterus Malpigii*, and those fabricated by *Spathe-*

* *Vide* Mr. A. Wilson on the growth of galls, 'Nature,' vol. xx, p. 55.

gaster baccarum, several of which constructions may be seen on a single leaf-vein, can only in a very restricted sense be regarded as fruit buds. Again, some *Aphis* galls rise simply out of the parenchyma of the leaf, and such do not seem to be specially attached to any leaf-vein. These *Aphis* galls have an individual growth, and draw their nourishment through the tissues of the leaves or stems.

M. L. Courchet* has well represented by plates the phases of growth in galls made by the *Pemphiginae*. He there shows the cellular structure altered from that of the leaf, by drawings of sections through different diameters.

M. Jules Lichtenstein has written much on the migratory habits of the *Pemphiginae*.† He states that he can trace a change of life and change of food in several species, just as Walker did in *Phorodon humuli*, which the last author says roves from the hop plant to the sloe. In the same way Lichtenstein says he can follow the migration of our elm-feeding kinds from the leaves of that tree to the roots of grasses where they hibernate.

More evidence is desirable before we can accept this sudden change of economy as an undoubted fact. More strange things certainly occur in the economy of insects, and we may perhaps hereafter find that some of the little known root-feeders have higher developments in known aerial forms.

The *Schizoneurinae* and *Pemphiginae* have sporadic habits, and seem to show but little forethought as to securing future sustenance for their young. Some species drop their young almost indiscriminately, for they place their young often on plants so unfitted for their nourishment, that they eventually die immature. Prof. Riley likens this apparent waste, or superabundance of life, to the wide dispersion of vegetable seeds; comparatively few of which find a nidus for

* Courchet, 'Étude sur les Galles, &c.,' Montpellier, 1879.

† Stettiner, 'Ent. Zeit.,' 1877, p. 489.

germination. In the animal world it is also much the same, for the number of mature individuals amongst fish, for instance, does not increase, notwithstanding that the roes of the cod and herring contain thousands of separate ova. Some of these ova are eagerly sought for food by other fish; and many of the rest, if hatched, become only larger prey for other animals.

The presence of a group of Aphides on a tree will not therefore lead to a certain conclusion that they were bred there, though the presumptive evidence is strong.

There appears to exist amongst some Aphidologists a certain confusion as to the terms pupa, egg, and embryo; and yet from the constitution of these bodies there is a clear distinction. I conceive that an ovum is necessarily composed of a vitellus with a germinal spot, and certain membranes, which after the fertilization of the egg and segmentation of the yolk, develop into the embryo. The embryo therefore must be clearly separable from the body which has developed it. A pupa (*chrysalis*), from its very name supposes an already organised form, and it is applied almost wholly to some metamorphic phase immediately preceding the imago or perfect state. The produce of the winged female cannot therefore be a pupa in this sense; unless two generations succeed each other, both of which must be winged. The young dropped by the imago has already its organs more or less developed, and, of course, it neither contains a vitellus nor egg adjuncts. It has, on the contrary, a greater analogy to a maggot or caterpillar, and thus, in a restricted sense, I have styled it a larva.

In many species of Aphidinæ these larvæ are born with a delicate membrane which enshrouds the young animal, and this with its shining, glairy, lubricating surface, gives it an ovoid appearance, and as such has doubtless deceived early authors.

On this account I have not used the word *Pupifer* or *Pupifer emigrant* employed by Lichtenstein.

Prof. Riley * states that in *Phylloæra* the embryos of the sexed insects remain quiescent in their sacs for a fortnight before they emerge from their delicate pellicles. This would imitate to a certain extent a hatching, but the phenomena are certainly distinct.

The gall-making Aphides are better represented on the Continent of Europe than in Great Britain. Passerini described twenty Italian species, including *Tetraneura* and *Apaloneura*. Derbès wrote on five species inhabiting *Pistacia terebinthus*, none of which are British. Lichtenstein has added others. With reference to conformation, Derbès remarks that in the terebinthine *Pemphiginae* the ocellus or supplementary eye occurs only in the winged forms. Some apterous females are wholly blind, for, like cave-inhabiting reptiles and beetles, they are cut off from light in their closed habitations, and eyes would be useless. Derbès, however, says the ocelli are to be found in the first generation of others, and that these are their sole organs of vision.†

A question may be raised whether these organs, containing, it is true, only five or six facets, are really referable to ocelli.

GENUS XXV.—SCHIZONEURA, Hartig.

Rostrum moderately long in the adult, much longer in the young.

Antennæ with six articulations omitting the terminal unciform process. The first and second joints very short, the third much the longest, and in all cases either ringed or cupped; the fourth and fifth about equal, and also usually ringed; the sixth joint rather shorter

* *Vide* seventh 'Ann. Report of State Entomologist,' pp. 91, 92, note.

† Derbès, 'Ann. des. Sc. Nat.,' 1869, p. 96.

than the preceding, and ending with a rudimentary joint; a small tubercle sometimes separating the two parts.

Cornicles rudimentary or none.

Legs short. Tarsi furnished with two claws.

Body either powdered with a mealy substance or furnished with wool-like tufts.

Wings moderately long. Cubital vein with a single furcation, and in most species springing at some considerable distance clear from the cubitus. The post-costal nervures of the hind wings nearly straight, and giving rise to the usual two oblique veins.

Some of the species of this genus are subterranean as well as aerial in their habits. Some are denizens of gall-like structures, the commencements of which are made by the insects which hatch from the ova laid the previous season. These females are wonderfully prolific, and become the stock-mothers or founders of the new colonies.

SCHIZONEURA LANIGERA, *Hausman*. Plates CV and CVI,
figs. 1—5.

Aphis lanigera, Haus., Germar., Kirby, and Spence.

Eriosoma mali, Leach, Mosley, Haliday.

„ *lanigera*, Fitch.

Myzoxylus mali, Blot., Tougaard, Amyot.

Schizoneura lanigera, Hartig, Kalt., Pass.

“The American blight.”

*Apterous viviparous female. (Queen Aphis.)**

	Inch.	Millimètres.
Size of body	0·070×0·055	1·77×1·39.
Length of antennæ	0·015	0·38.
Cornicles rudimentary.		

* No very satisfactory English name has been proposed for the immediate produce of the egg of *Aphis*. As before stated, the hatched insect is always a so-called female (Lichtenstein's *Pseudogynæ*), and she is the founder of the whole series of generations, ending in the perfected

Colour dark shining brown, approaching to black. Form oval, flat, and carinated; dorsum domed and deeply marked by sutures. Eyes very small. Antennæ and legs very short, black or reddish. Nectaries represented by pale papillæ with a central spot. Cauda rudimentary. Body sparsely covered with a cottony coat which is most developed at the tail end. Rostrum very short, only reaching to the second coxæ. The generations from the queen *Aphis* differ much both in form and size from their parent. They are of various shades of red or warm brown, and are less flattened and longer in the body. When first born they have a most disproportionately long and stout rostrum protruding far beyond the tail. This organ soon ceases to grow, whilst the rest of the insect rapidly develops. The insects, when adult, exude from their pores long silky threads, which curve round a centre, and often form long spiral filaments, under which they hide.

I subjoin the substance of Hausman's remarks on the habits of *Schizoneura lanigera*. This species feeds on the sap of the bark of the apple tree, *Pyrus malus*. They live in dense companies and produce by the incessant pricking of their beaks warty or spongy swellings on the stems. Where the bark is hard, they work under it, and insert their sucking tubes into the softer parts, from whence they draw their nourishment.

"The woody knots are caused by the increased flow of the sap to these wounds. In the spring and early summer, white cottony masses may be seen hanging in long tufts from the branches of the trees in orchards. Small twigs thus attacked produce stunted leaves and fruit, and they often die."

males and females. From a certain analogy that seems to exist, I have usually styled her the *Queen Aphis*, inasmuch as like the queen bee (*Bombus?*), the queen wasp, and queen ant, she is the architect and also the mother of the whole brood. Kaltenbach and Koch use the word *Stammütter*, which Riley adopts in its strict translation "Stem-mother." Founder or foundress does not well commend itself. M. Lichtenstein uses the word fundatrix, which, though sufficiently explicit, is rather uncouth in English. I propose, in a restricted sense, *Queen Aphis* for the immediate issue from the egg.

The popular name of this pest in England is the "American blight." Dr. Asa Fitch, in his report on the noxious insects of New York, however, strongly protests against the idea of its being an exportation from America. Serville and Amyot state that it was first seen in Europe in 1787, and that probably it came through England from America. Sir Joseph Banks traced its origin in England to a nursery near London, whose owner it appears had recently received a consignment of apple trees from the New World. The ravages of the insect were at first confined to the vicinity of London, but the pest speedily spread into the Devonshire orchards, and with such effect, that at one time the making of cider around threatened to be abandoned. There seems to be some doubt whether or not France received it in its travels eastward. It was noted in the Department of the Cotes-du-Nord in 1812, and in 1818 it was found in the gardens of the École de Pharmacie of Paris. In 1822 it was common in the Departments of the Seine, the Somme, and the Aisne. It reached Germany in 1801 and Belgium in 1812. Throughout France to the Mediterranean it is now common, but Passerini, in 1863, said that then it was not frequent in Italy, though met with in Liguria. The fact that the apple bark is now known to harbour the egg, is a sufficient explanation of the wide area over which the insect now has obtained a footing. Prof. Cyrus Thomas, laying stress upon the fact that the cultivated apple is not an American production, states his conviction that the pest moved from Europe to America. As, however, it is found there on the native crab, this objection would seem to vanish.

Prof. Riley believes that these American apple-feeding *Schizoneurinae* are identical with the European. From the description of the western insects I do not doubt that they are so.

The Pupæ.

Oval, head and thorax very broad. Eyes large. General colour of the insect dull brown, with yellow antennæ, legs, and wing-cases. The winged form of this insect is by no means common in great Britain. In December, when the snow was on the ground and the thermometer stood at 21° Fahr., I found the apterous larvæ alive and plentiful on the apple branches under the tufts of cotton. They were then crowded with young, and had every appearance of incipient hibernation. There were no traces of pupæ or winged forms.

M. Lichtenstein, however, very kindly forwarded me pupæ and winged forms in September, 1878. They arrived from Montpellier in an active condition, and from these specimens I am enabled to figure the insects on Plate CV. The pupæ are but slightly clothed with down, and the antennæ are more simple in structure than those seen in the winged insect.

Winged viviparous Female.

	Inch.	Millimètres.
Expanse of wings	0·200	5·08.
Size of body	0·050 × 0·025	1·27 × 0·62.
Length of antennæ	0·025	0·62.

Uniform colour dusky brown, approaching to black. Prothorax rather paler. Abdomen carinated and ringed. Antennæ short; third joint long and strongly ringed, the three following joints less markedly so. Wings voluminous and rounded at their apices; membranes smoky and slightly punctured. Cubitus broad, ending with a large trapezoidal brown stigma. Veins black, cubital vein with a single furcation.* Legs

* The neuration of the wings of insects furnishes such valuable characters that variation is of interest, as indicating by an increased complexity a possible ascent to a higher type. In *Sch. lanigera* there is a tendency shown to increase the venation of the hinder wings by a divarication of the costal vein towards the apex.

short. Hausman and Knapp never met with this alate form, and even doubted the existence of such. Nevertheless, M. Lichtenstein stated that in September they were at that time almost swarming in the orchards of the South of France. During their passage through the post many young were born, and many of these under a deep lens proved to be the non-rostrated oviparous females. Buccal processes represented the rostrum in these very minute insects, and the degradation was also shown in their half-developed antennæ and tarsi. In accordance with what we might expect, a rudiment of the single egg in these young examples was alone traceable. The colour of the oviparous female is yellow tinged with red. The size is not more than $0\cdot003 \times 0\cdot002$ of an inch. The eyes are very small.

In the same quill, and mixed in about equal proportion, I found also young Aphides of a brown or blackish tint. They were larger than the above, and were fully developed with reference to their mouth-organs, the rostra in some cases trailing beyond the tail end. These insects can scarcely be looked on as the males, for both Lichtenstein and Riley state that both the sexes are non-rostrated, and incapable of taking in nourishment. The untraced but possible presence in the quill of a viviparous female doubtless would explain the occurrence of these rostrated forms.

I am not able to speak from personal observation as to the fact stated by Goureau and others, that the European *Schizoneura lanigera* descends into the soil and attacks the apple roots in winter time. There seems to be no good reason, however, to doubt that it does so occasionally. Certain it is, that the apterous larvæ will bear with impunity great cold whilst covered with their cottony tufts. I have taken them winged in December, with snow on the ground and the thermometer marking 21° Fahr. They were then lively and I could trace no presence of the perfect sexes, so that in all probability they would in this

instance have hibernated on the branches and trunk. Dr. Cyrus Thomas, of Illinois, states that the apple *Schizoneura* of America certainly attacks the root and raises knots and spongy excrescences on its fibres. With us the apple tree is often attacked close to the ground on what has been called the collar of the stem, but this is not quite the same as feeding on the root.

Numerous receipts has been given for the destruction of this pest, but they all seem inefficient in the cases where orchards extend over many acres. In the garden much may be done by encouraging their natural enemies, *Coccinella*, *Syrphus*, *Hemerobius*, and even by intentionally introducing insects already infested by Hymenopterous parasites. As purgative washes may be mentioned, solution of calcium sulphide, soap-suds, solution of wood-ashes, coarse petroleum, kreosote, and tobacco-water made by infusing one pound of the leaf in four gallons of hot water. A single heavy thunder-shower will do far more execution, however, than the best efforts of the orchard keeper.

SCHIZONEURA FODIENS, *Buckton*. Pl. CVI, figs. 6—12.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·055 × 0·035	1·39 × 0·88.
Length of antennæ	0·015	0·38.

Globose, shining. Body uniformly of a ferruginous yellow; slightly mealy. Head rather darker, rich brown. Thorax and abdominal rings obscurely marked laterally by small dark depressions. Antennæ slaty brown, about three quarters the length of the body. The joints finely ringed or cupped as in *Sch. lanigera*. This character, however, is best shown in the alate insect. Eyes none or very rudimentary. Cornicles

Brunmeister,
1835-

Handb. d. Ent. II, 1835. (p. 274)

none. Rostrum reaches beyond the third coxæ. Insect slightly hirsute.

Taken plentifully at Haslemere from October to the middle of November on black-currant roots, from four to six inches underground.

Pupa.

Has much the colour of the larvæ described above, but it is redder, the size larger, and more elongated. Wing-cases and thoracic lobes ferruginous yellow. Abdomen reddish. Eyes of the normal size. Rostrum much shorter than in the apterous insect, reaching not much beyond the first coxæ.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·210	5·33.
Size of body	0·070 \times 0·025	1·77 \times 0·62.
Length of antennæ	0·030	0·76.

Body oblong. Head, thorax, and legs shining brown or black. Eyes large and reddish brown. Antennæ six-jointed, the nail-like process not being counted. Joints beautifully ringed. The third joint equal to the three following taken together. Abdomen slaty grey. Rostrum does not reach to the second coxæ. Wings somewhat fuscous, dull, and coarsely punctured; carried horizontally when at rest. Insertions and stigma ochreous yellow. Cubital vein once forked; it stops short of any union to the cubitus. Hind wings with two oblique veins.

This is the third recorded example of subterranean habits shown by the *Schizoneurinae*.

Sch. fodiens makes nests lined with cottony fibres, within which twenty or more individuals congregate.

In October the larvæ become very scarce, all the young passing into pupæ and winged insects.

I subjoin, in Pl. CVI, fig. 9, a drawing of the some-

what vermiform young, fifteen minutes after birth, produced from the winged mother. In all probability these are the sexed forms. Many centipedes affect these nests; they do not appear to molest the Aphides in any way.

Sch. venusta, Pass., has not yet been taken in this country. It feeds on the roots of Bromus.

SCHIZONEURA FULIGINOSA, Buckton, Pl. CVII.

Apterous viriparous female.

	Inch.	Millimètres.
Size of body	0·090 \times 0·040	2·27 \times 1·01.
Length of antennæ	0·035	1·88.
„ cornicles	mere warts	„

Sooty black, rather shining. Abdomen carinated and ringed. Eyes black. Antennæ sooty grey. Whole insect hirsute, and slightly powdered with a mealy substance. Rostrum reaches to the third coxæ.

Pupa.

Wholly black, dull, and covered with a grey, curly, and woolly coat. Wing-cases greyish-black. Body somewhat fusiform.

Winged viriparous female.

	Inch.	Millimètres.
Expanse of wings	0·280	7·10.
Size of body	0·085 \times 0·035	2·15 \times 0·89.
Length of antennæ	0·045	1·13.

Wholly black, very hairy, slightly mealy. Antennæ with the third joint simple, that is, not ringed. Wings moderately long. Cubitus and nervures pale brown. Stigma long, stigmatic vein nearly straight. Post-costal nervure (hind wing) straight, with the two oblique veins also straight, divercating from the same

point, and at almost equal angles. The abdomen has several pores disposed upon it separate from the cornicles.

These insects are common on *Pinus Austriaca* at Weycombe, Haslemere, from early May to December. They also occasionally visit *P. sylvestris* and *P. Pyreniaca*. They range themselves in rows down the leaflets, and at their insertions or axils the *Aphis* makes small white, cottony tufts. These tufts are frequently visited by ants.

I think it possible that Léon Dufour's *Aphis pini maritimæ*, which he says is distinct from *A. pini*, Linn., may be the above-described insect. His description, however, is too short to decide even upon its genus.

Late in November I collected, in company with the above described, some very small examples of a bright yellow or an orange-red colour. They were, however, all rostrated, and yet as they contained no internal embryos it is possible that these small individuals are the apterous males, and I am inclined to regard them as such. It has not yet been proved that the males of all the *Schizoneurinæ* are non-rostrated and incapable of feeding.

A solution of caustic potash develops from these Aphides a fine crimson, which, however, does not seem to be a very stable dye. The large oily globules to be found in these insects, under the action of the same reagent, crystallise into radiated masses like cystine. The presence of a colouring matter seems to approximate this and other genera to the scarlet-producing *Coccus* of the Cactus.

SCHIZONEURA ULMI, *Linn.* Pl. CVIII and CIX, figs.
1—4.

Aphis foliorum, De Geer.

Schizoneura ulmi, Kalt., Koch., Pass., Riley, Thomas.
, *Americana*, Riley (?).

Apterous Queen Aphis.

	Inch.	Millimètres.
Size of body	0·095 × 0·045	2·41 × 1·13.
Length of antennæ	0·012	0·30.
,, cornicles	rudimentary.	

Broader and larger than her offspring, even when they are adult. Covered with a cotton-like fibre. When denuded, flat-oval, sometimes almost circular. Dorsum domed and ringed. Colour variable with age, from pale green to dark olive; mottled. Four series of longitudinally-arranged pores occur down the back, each of which gives rise to the cotton-like fibres under which the insect conceals itself. Head and thorax very small and black. Antennæ and legs very short, and black also. The latter when contracted under the body quite hidden, as in *Coccus*. Rostrum very short, reaching only to the second coxae. Antennæ degraded in type, and usually restricted to at most five joints. In later generations these organs regain their full development.

The leaves of *Ulmus suberosa* are attacked by this insect immediately after she leaves the egg. She commences her punctures under the leaf almost directly it unfolds from the bud, and she causes it to blister into numerous cavities, within which she nestles. Shortly afterwards the leaf curls from above downwards into a roll of a sickly yellow colour. Within this roll a large number of young are born. They are of a lengthened form, and of a lively green. After several months they develop wing-cases and become pupæ, from which the imagos of the first series ("Pupifères emigrantes," Licht.) emerge in turn, and take wing for the purpose of dropping their progeny on other trees and branches.

These young are born in the form of yellow ova, and might be almost mistaken for such, except from the existence of two black eyes which are sufficiently perceptible. The casting of a delicate membrane

permits the disengagement of the limbs, and the rapid growth of a golden yellow pilose coat. The growth of this covering is remarkable under a high microscopic power. The hairs shoot out like magic from minute papillæ, and in about half a minute the yellow shining body, which rapidly pulsates during this process, is invested with the setose covering alluded to. On one occasion I counted the rate of these births, and I found that two, on an average, were born per minute, and that for a considerable time.

When first born the investing membrane seems to have a lubricating substance upon it. This must have some tenacity also, for some of these young, just commencing to walk, carried off on their backs several of their less aged sisters. After this multiplying process has continued for an hour or more, it is not to be wondered that the imago should much change her shape.

These young, the produce of the first generation of winged females, have long rostra.

The pupæ are long, pale green, and clothed with white filamentary matter, like the larvæ.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·280	7·11.
Size of body	0·075 \times 0·030	1·89 \times 0·76.
Length of antennæ	0·040	1·01.

Long oval, wholly black. Abdomen much ringed, and brownish. Antennæ with third joint very long, longer than all the other joints taken together; third and fourth joints cupped or ringed. Rostrum short. Eyes black and prominent. Abdomen furnished with numerous white filaments, mostly of a cork-screw form, which is apparently caused by the extrusion, from minute pores of silky matter, in a plastic condition. These filaments are most abundant towards the tail end. Wings broad and rounded at their tips; membranes

rather smoky in tint. The cubitus and other veins black; stigma broad and dilated posteriorly. Legs moderately long and black. The wings are generally carried pentwise, but sometimes the horizontal position is assumed.

Some years this insect is very plentiful throughout June and July on the common Elm, *Ulmus campestris*. On shaking the boughs, abundance of the flocculent matter falls, mixed with numerous colourless globules. These have been previously voided from the anus of the insect, and being dusted with mealy matter, do not soil the surfaces on which they roll. They have the appearance of grains of bright silver sand, and freely run on glass without wetting it. If breathed upon, however, they burst and leave only a spot of liquid, together with fragments of what would appear to be a film or delicate membrane. These globules are not alone produced by *Schizoneura*, but they seem to be a usual accompaniment to those Aphides which nest in close covered structures.

It is suggested that by the isolation of these globules the insects are not contaminated by their own excreta.

Prof. Riley describes an elm Aphis under the name of *Schizoneura Americana*, and which he thinks is distinct from *Sch. ulmi* of Europe.* One peculiarity of this insect is, that it rolls the leaves from below upwards, from which I gather that it feeds on the upper surfaces instead of on the lower, as with us. There appears also to be some slight variation in the wing-veining, and in the occurrence of four instead of three hooklets on the lower wings.†

In 'Notes on the Aphididæ of the United States,' Messrs. Riley and Monell have given a full and interesting account of this insect, and they may be congratulated on their success in tracing the steps of development throughout the six generations which intervene

* 'Bulletin of Survey,' vol. v, No. 1, 1879.

† Those British insects which I have examined show also four hooklets on the lower wings.—G. B. B.

between the exclusion from the egg and the appearance of the perfect sexes.

With slight variations these stages of development may be regarded typical of the genus.

Numerous workers have, however, been on the same track, and have greatly added to our knowledge; amongst whom may be mentioned Messrs. Lichtenstein, Courchet, Kessler, and Cyrus Thomas, of Illinois.

Briefly the life-history is comprised in the following remarks :

A careful examination towards winter of the crevices of the bark of such elm trees as have been infested during the past summer will sometimes lead to the discovery of small, dull yellow or brownish ova about 0·05 millimetre in length. Some of these eggs will be found free of all downy matter, others are wholly concealed by such, whilst here and there will be seen some partially enclosed, and protected by the exuviae of their dead mothers, who have died before accomplishing their task of oviposition.

These impregnated single eggs—for only one is laid by each individual—hatch and produce the queen *Aphis*, stock-mother, or fundatrix of Lichtenstein. These commence the distortion of the young leaves in spring. They moult their skins about three times, and after the expiration of a few days, dependent on temperature and moisture, they begin to people the cavities of the curled leaves with young of the second series.

Some of these migrate to other leaves, and eventually the third generation arrives, which goes through the pupal stage, acquires wings, and then spreads over other trees.

This last is the “emigrante” stage of Lichtenstein. The life of these winged females appears to be but short. They produce about twelve young each at intervals perhaps of half an hour on the average, and then shortly after they die.

According to Prof. Riley, the American *Schizoneura ulmi* is not so prolific as the European.

I have often witnessed the rapid births of these insects. These young, which form the fourth generation, are very active, they run swiftly and have long rostra, by which they suck up the sap, and thereby grow rapidly. They course up and down the elm twigs and show their presence by the plentiful tufts of cotton with which they powder the leaves. In Belgium, near Spa, I have seen the elms hoary with this cottony substance, and then the shaking of a bough produces a shower of liquid exudation and white flocks.

The fifth generation appears also to be apterous; but the sixth once more shows pupal forms and discloses the corresponding imago towards the end of June and throughout July.

These are "les pupifères" of Lichtenstein. Except that they are usually much smaller, they do not greatly differ in appearance from the earlier alate insects. They roam far and wide on the wind currents: those which discover suitable quarters establish themselves. According to Riley, they particularly choose the bark, and there they give birth to the seventh and last generation—the perfect sexes. These are very diminutive, and on that account for a long time they were overlooked by Entomologists. They are of various shades of colour, from bright yellow to orange and red.

The males, so far as my experience goes, are born with rostra, but these organs disappear after a moult.

This degradation of type in the sexes is remarkable, and it has been commented upon by Lichtenstein, Riley, Löw, and others. It also obtains in other species of *Pemphiginae* and *Schizoneurinae*.

The oviparous females are, on the other hand, born mouthless, and thus are incapable of obtaining nourishment. The ovum nevertheless enlarges, perhaps from the imbibition of water through the parent.

After retiring into the hollows of the elm bark, the females lay their single eggs, or else die without extruding them, which nevertheless live, as before noticed, to recommence the cycle of the ensuing year.

Lichtenstein says that the produce of these winged females descend into the ground, and that they hibernate at the roots of various grasses.

If I understand him rightly, he maintains that the cycle of these insects' lives spreads over two years, and the sexes are not seen till the second season. On the other hand, Prof. Riley says that this habit is not in accordance with his own or M. Derbès observations on *Pemphigus cornicularis*.

At present this subterranean habit is so far an open question that it requires more attention than has been bestowed by naturalists upon it before it can be said to be scientifically proved.

In the State of Mississippi *Schizoneura Americana* sometimes infests the Elm trees so much that Prof. Riley has seen a matted mass of dead insects under the trees from three to four inches thick. This decaying mass was the food of numerous other insects.

During some years the English Aphides are sufficiently plentiful, but occasionally they are difficult to find even in their old haunts. Such was the case in 1879 at Malden, in Essex, when Mr. E. A. Fitch could only send me a few winged forms collected from rolled elm leaves in the month of October. These were so small that they might almost be taken for another species. It is probable, however, that they were the winged mothers ready to transport the perfect sexes to the places of oviposition. Their expanse of wings was only 0·155 of an inch against the nominal 0·310 of an inch, which last measurement represents an insect born in June.

I have occasionally plucked leaves of the Elm rolled *from below upwards*, but I could not discover any unusual specific distinctions in the insects inhabiting them.

I quote M. Lichtenstein's words with reference to the migration of these Aphides. "Ce qu'il y a de plus curieux, c'est que la *Schiz. Americana* ne quitterait pas l'ormeau et effectuerait ses sept changements sur le

même arbre, tandis que chez nous, bien certainement, non seulement pour l'espèce actuelle, mais pour toutes celles que je cite, *il y a migration*, et pas un puceron ne reste sur l'ormeau après le mois de juillet. Au moins, je n'ai jamais pu en trouver.”*

SCHIZONEURA LANUGINOSA, Hartig. Pl. CIX, figs. 5—10.

Réaumur, Germar, Kalt., Koch, Pass., Kessler.

Mimaphidus ulmi, Rondani.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·050 × 0·025	1·27 × 0·63.
Length of antennæ	0·020	0·51.

Form long-oval. Colour black, smooth, clothed with cottony filaments. Eyes very small. Antennæ short, and often showing but four articulations. Rostrum black, reaching to the second coxæ. Legs short.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wing	0·230	5·84.
Size of body	0·055 × 0·020	1·39 × 0·51.
Length of antennæ	0·020	0·51.

Black. Antennæ strongly ringed and very short, six-jointed. Abdomen at the apex furnished with white filaments. Rostrum short, cornicles mere pores. Wings hyaline. Stigmata large, blackish green. Veins black and very slender.

This *Schizoneura* forms gall-like masses at the ends of the twigs of *Ulmus campestris* and *U. suberosa*. They are densely hairy, and vary in size from a small

* ‘Extrait de la Feuille des Jeunes Naturalistes,’ Août et Septembre, 1879.

nut to masses as large as a green fig, or even larger. They are corrugated longitudinally, and of a green or brownish-green colour. These curious masses are formed by the Queen Aphis—the produce of the egg. She makes her punctures near the mid-rib of the leaf, and there these distorted masses occur either single, double, or else grouped in bunches. On account of their size and hairy character they may be easily distinguished from the smoother galls made by *Tetraneura ulmi*. The two galls may, however, be found simultaneously on the same tree.

They attain their full size in August, at which time they contain thousands of plant-lice, both apterous and winged. A small opening is formed usually at the summit of these galls, from which the winged mothers make their escape as soon as they feel the imperative calls for migration.

In 1860, Mr. R. McLachlan, travelling in the South of France, gathered a number of such galls, which were in extreme profusion; trees twenty feet high being one mass of galls. He remarks, “I collected some small branches, intending to bring them home, but they made such a mess from the liquid in the galls that I was forced to throw them away.”*

I have received living insects from M. Lichtenstein, at Montpellier, which in all respects seem to be identical with the British species.

I have also been kindly furnished with similar galls by Mr. Brady, from Rainham in Essex. The bodies of the pupæ were full of embryos, which shows that the change of form and moulting does not interfere with the process of internal budding, since the young would not be born until the parents had passed into imagos. The largest galls I have seen were gathered by Mr. Thomas Brown from Elms near Cambridge, in the year 1871. I obtained these through the late indefatigable naturalist, Mr. Edward Newman. The largest of these measured $3\cdot0 \times 2\cdot5$ inches ($=73 \times 66$ milli-

* *Vide Ent. Month. Mag.*, vol. iii, p. 157.

mètres). They were so remarkable that I figure them from the outlines furnished by Mr. Newman himself, but necessarily much reduced from their natural size. I also received from Mr. E. A. Fitch a mass of contorted galls gathered by him at Malden in Essex.

These galls take various shapes; but no certain inference, I think, can be made as to any diversity of species simply from the different forms of their habitations. When cut open these galls showed the midrib and other veins of the leaf greatly modified and expanded. At first we might be disposed to think that the insect had effected a separation of the upper membrane of the leaf from the lower, but an examination of the interior of the gall shows that these veins form a sort of framework of ribs to the whole cavity, arching it over, and giving us more the idea that the leaves had united at their edges to form the hollow spaces. The interior is lined, as is also the outside, with a velvet-like pile, and the walls of the cavity are more or less blown up into hemispherical bubbles.

The second winged forms, which appear late in the autumn, and which probably produce the perfect sexes, are smaller than the winged females, which appear early in June. The former only are figured in the above-mentioned plate.

The occurrence of *Schizoneura lanuginosa* in England is more plentiful in some years than in others. During the cold wet season of 1879 scarcely an example could be found on those Elms which usually formed their resort.

Bonnet noticed these galls more than one hundred years ago, and tells us that in his time they were employed in Persia, China, and the Levant, under the name of "baizonges," to assist in extracting the scarlet dye from the cochineal insect. Bonnet showed that these "vessies" were produced by an *Aphis*, and not by a *Cynips* or gall-fly as supposed.

Passerini remarks, with reference to the liquid obtained from these pseudo-galls, "Rustici nostri liquore gummoso-saccharino in gallis collecto utuntur

ad curandum vulneribus sub nomine olei Sti. Joannis." It is not unlikely that the astringent character, coupled with the viscosity of this liquid, may have some healing effects, and beneficially exclude the air from open wounds.

M. Lichtenstein has hazarded the supposition that *Sch. venusta* of Passerini is the underground form of *Sch. lanuginosa*. Although the migration of *Phylloxera vastatrix* from the root to the branches of the vine is fully proved, and I have shown that both aerial and subterranean forms exist in *Schizoneura fodiens*, a too hasty generalisation should be avoided. A close and pains-taking observation will alone justify the fusion into one of these two apparently well-marked species.

SCHIZONEURA CORNI, *Fab.*, *Schr.*, *Haus.*, *Kalt.*, *Pass.*,
Licht. Pl. CX, figs. 1—4.

Schizoneura vagans, Koch.
Andæcia corni, Koch.

Oval, flat, dull black. Abdomen brownish; legs paler. The first brood appears in England about August upon the white cymes of the dogwood *Cornus sanguinea*. In Germany they appear in greater plenty; and late in August and September, when they assume wings, Kaltenbach says that the air is so full of them they fly into the eyes, nose, and mouth, to the great annoyance of the traveller. At other times they swarm like gnats in the slanting rays of the sun.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·250	6·35.
Size of body	0·080 × 0·030	2·02 × 0·76.
Length of antennæ	0·040	1·01.

Velvety-black, with the first three abdominal and also the apical rings ferruginous. Eyes dark-brown. Antennæ, legs, and apex of abdomen hairy. Antennæ much tuberculate. Rostrum reaches to the third coxæ. Wings with a smoky membrane, and covered by minute punctures. Cubitus strong, with yellow insertions, and ending in a large brown stigma, the fore border of which has a black internal rhomboidal spot. Other veins black; the cubital vein does not quite reach the cubitus.

Koch gave the name *Sch. vagans* to this species, from the wandering habits of the winged form. Riley describes an American *Aphis* with the same habit under the name of *Pemphigus ragabundus*.

In the autumn the English insect may be found mixed with Aphides of other kinds on a variety of trees. I have taken them on the medlar, the honeysuckle, the plum tree, and the oak. Late in November the winged females continue full of embryos, most of which would appear to be dropped on plants unsuited for the food of the young *Aphis*. Professor Riley draws a parallel between the profuse dispersion of seeds into sterile places and the apparently aimless deposits of young by many of these insects.*

When the food plant is in abundance the insect is much spread in proportion, and this abundance has been thought to explain the myriads of *Phylloxera vastatrix* which now devastate the vines of France and Italy.

I cannot see either in Koch's diagnosis or his figures any sufficient reason for separating *Sch. corni* from this genus, for I believe, with Passerini and Lichtenstein, that *Sch. vagans* is really Hausman's *Sch. corni*, and therefore I place it as a synonym. Thus Koch's new genus, *Andaecia*, to me seems to be unnecessary.

M. Lichtenstein, with his usual liberality, sent me

* *Vide 'Notes on the Aphididæ of the United States,' Riley and Monell, Washington, Jan., 1879.*

several living winged individuals of *Sch. corni* from Montpellier. They arrived on the 5th of December, and on their journey they gave birth to several yellowish-red and greenish young. M. Lichtenstein regards these as the true males and females, and very probably they are such. Nevertheless, a careful examination under a high magnifying power did not show to me either any included egg or the usual male organs. As the insects, however, could not have been many days old, these structures may not have had time for development. One argument in favour of these young being the two sexes is, that they are very different in form and colour from the rest. The presumed male is rather linear, and cylindrical; shining yellow, with well-developed antennæ and prominent eyes. The female is stout, oval, green, and has eyes much smaller. Ten of these forms were examined, and all were distinctly *rostrated*. The sizes were, for the male $0\cdot027 \times 0\cdot011$ inch, for the female $0\cdot024 \times 0\cdot013$ inch.

M. Lichtenstein thinks it probable that the *Schizoneurinae* have both aerial and subterranean forms; that is, that they migrate from the roots of grasses and wheat to the branches of trees. In this manner he thinks the Continental *Sch. venusta* of Pass., which affects many different kinds of grass roots, may prove to be the winter form of *Sch. ulmi* or *Sch. lanuginosa*. I have no experimental proofs of such migrations from tree to tree to offer; and Professor Riley is inclined to deny altogether the fact of this migration.

The before-mentioned *Pemphigus vagabundus* is not likely to be met with in this country; for it is said to breed on the cotton-wood of America, on the leaves of which it forms large cockscomb-like galls, and also to be unable to subsist on any other trees. Nevertheless, in Missouri, the winged females may be plentifully taken at the fall of the year, on numerous dissimilar plants, on which, like their European allied

sisters, they wastefully drop their young, and earn their specific name vagabundus.

The States of America and Italy furnish several interesting *Schizoneurinae* unknown in Britain.

III.

PEMPHIGINÆ.

UPPER WING WITH CUBITAL VEIN SIMPLE.

LOWER WING GENERALLY WITH TWO OBLIQUE VEINS.

PEMPHIGINÆ.

The habits of this Tribe are very similar to those of the preceding ; that is, they are gall-constructing, and in some instances they are partly subterranean. Although the known species are not very numerous, a considerable literature exists on the group, which is chiefly of modern date. This attention bestowed is partly due to the obvious distortions produced by these insects on the leaves, or their foot-stalks, of various trees. These curious excrescences and abnormal growths take a great variety of form, and to a certain extent show such individual characters as materially assist in identifying the species which construct them. The characters of some species are not very sharply defined, and they would not be very easy to identify if the life-history and various methods of building their habitations were ignored.

GENUS XXVI.—PEMPHIGUS,* *Hartig.*

Rostrum as in *Schizoneura*.

Antennæ short, with six joints, omitting the nail-like process. Third joint about equal to the three following taken together. The third, fourth, and fifth joints commonly ringed; the sixth joint longer than that of *Schizoneura*.

Cornicles wanting.

Wings with no furcated cubital vein; this vein, as in the last genus, being unattached to the cubitus; stigma large and trapezoidal; the two oblique veins usually start from the same point. The post-costal nervure of the hind wing somewhat angular, from which angle the two oblique veins spring.

Legs short, particularly in the apterous forms.

It is to be noted that sharp characters cannot always be drawn from minute differences in the antennal joints. These organs become developed during the progress of the insect towards its imago state, for here it is that the climax seems to be reached and not in the true sexes. These last suffer a degradation in type, which appears in the stunted antennæ and total absence of efficient buccal organs.

Neither can any safe characters be made from the deflexed or vertical position assumed by the wings whilst at rest. The horizontal and pent-wise position has been before noticed in some of the foregoing genera.

PEMPHIGUS FUSCIFRONS, Koch. Plate CX, figs. 5—9.

Amycla fuscifrons, Koch.

Pemphigus Boyeri, Pass.

„ „ *muidis*, Löw.?

Aphis radicum, Boyer de Fonscolombe?

* From $\pi\epsilon\mu\phi\iota\varsigma$, $\iota\gamma\omega\varsigma$, a bladder or pustule.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·080 × 0·040	2·02 × 1·01.
Length of antennæ	0·017	0·43.

Long oval, golden yellow. Head with two dusky spots on occiput. Antennæ five-jointed, the fourth the longest. Abdomen naked or but slightly clothed with cottony fibre, and furnished with small marginal punctures. Nectaries none. Rostrum reaches to the hind coxa. Eyes conspicuous and brown. Antennæ, back of the head, and legs fuscous.

Pupa.

Long oval, yellow. Head, antennæ, and wing-cases fuscous. Abdominal hind rings furnished with numerous tufts of stiff fibre like spun glass, each tuft issues from a distinct glandular opening placed not at the sutures but in the midst of the body-ring.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·220	5·58.
Size of body	0·080 × 0·030	2·02 × 0·76.
Length of antennæ	0·030	0·76.

Head and thorax black. Antennæ six-jointed, not counting the nail. The third joint the longest, which, with the following joint, is slightly ringed. Abdomen naked, fuscous, or dirty green; nectaries none or imperceptible. Eyes brown. Antennæ and legs fuscous. Wings with greyish membranes, slightly punctured; stigma fuscous, with darkish stripes at their apices; cubitus, other veins and insertions, dark brown. In the hind wings the two oblique veins form with the costal nerve a tridental fork.

The Queen Aphis (*fundatrix*) is large, pale lilac, with green spots, indicating the embryos. Head, legs, and antennæ very small; whilst the abdomen is very large. Antennæ restricted to four joints.

The true sexes are very small and non-rostrated. Lichtenstein says they copulate soon after birth and then die. He, like other authors, speaks of what he calls the monœcious character of Aphides, and asks, "Is there any other instance amongst insects known in which the male and female proceed from the same egg? Is the difference between a monœcious and dioecious egg recognised?"

In the month of June I received from Montpellier numerous insects for comparison, which M. Lichtenstein regarded as *Amycla fuscifrons*, of Koch. There seems, however, to be some points of difference between the English and the French insects. The winged foreign examples are smaller than the British; their antennæ are less ringed, and they have a peculiar, though slight, clouding throughout the whole length of the wing veins. I am unable to say, from my present information, whether these differences are only climatal.

Pemphigus fuscifrons may be taken plentifully at Haslemere at the roots of *Hieracium murorum* and *H. sabaudum*, and also at the roots of *Lactuca*. The insects form cavities in the earth which are sparsely lined with cotton. The imagos rise to the surface of the ground during the months of August, September, and even as late as November. The females, to the naked eye, have a sooty hue, more especially as regards the wings, which, unlike other Aphides, are carried horizontally. Koch found *Amycla fuscifrons* plentifully feeding at the roots of the oat, *Arena sativa*. This insect certainly feeds on a variety of plants.

Some remarks may here be made on the maize Coccus of Léon Dufour, inasmuch as Dr. Franz Löw, of Vienna, includes *P. fuscifrons* amongst the synonyms of that insect.* Dr. Löw says that the *Aphis* which often causes such great damage to the crops of Indian maize in Hungary and Styria has been long known to

* Dr. Franz Löw, 'Ueber eine dem Mais schädliche Aphidenart,' p. 6; Nov., 1877.

science. He states that it was first erroneously described by Léon Dufour in 1824 under the name of *Coccus zeæ maidis*.* But it is difficult to suppose that the clever and accurate anatomist Dufour was misled as to the characters of *Coccus* and *Aphis*. There is, therefore, room to doubt the identity of these insects, and the more so, that a maize *Coccus* exists.

Löw also states his belief that other authors have described the insect under different names. Thus he says Boyer de Fonscolombe,† in 1841, described it under the name of *Aphis radicum*; and that Passerini, in 1856, provisionally (*pro parte*) ranged it under his synonym of *Pemphigus Boyeri*, but did not know of its habitat at the roots of maize plants. Again, Löw considers that the following insects are identical with this maize *Pemphigus*, *Amycla fuscifrons*, *Endeis rosea*, and *Endeis bella* of Koch. He gives as additional maize-feeders *Aphis zeæ*, of Curtis, *A. maidis*, Fitch, *Sipha maidis*, Pass., and *A. maidis*, Bonafrons. He says the last-named insect more nearly approaches the genus *Siphonophora*. Passerini adds to these *Toxoptera graminum* and *Tychea setasiu* as infesting *Zea Mays*. Löw's insect fairly agrees with the British specimens of *P. fuscifrons* which I have seen, but he says the wings are, in repose, carried pentwise, covering the body (dach-förmig).

Whilst I have no doubt that the above English insect is the same as that described by Passerini as *P. Boyeri* and synonymous with *Amycla fuscifrons*, it appears to me that, if Koch's name is to be changed at all, it ought to revert to that given by Fonscolombe, viz. *P. radicum*; that is, assuming that the last insect is identical with the two former. I prefer leaving it as Koch described it; for Fonscolombe's insect might prove to be *Forda*.

Passerini found *Pemphigus fuscifrons* feeding at the roots of numerous kinds of gramineæ, *Zea*, *Sorghum*, *Panicum*, *Oryza*, *Eragrostis*, *Lolium*, *Coix*, &c.

* 'Ann des. Sci. Naturelles,' 1824, t. ii, p. 203.

† 'Ann. des Sci. de France,' t. x, 1841.

PEMPHIGUS BURSARIUS, *Hart.* Pl. CXI, figs. 1—7, and CXIII, figs. 6—8.

Aphis bursaria, Linn., Fab., Sch., Kirby and Spence.

Eriosoma populi, Mosley.

Aphioides bursaria, Rondani.

Pemphigus bursarius, Kalt., Koch., Pass.

Apterous viviparous female (Queen Aphis).

	Inch.	Millimètres.
Size of body	0·110 × 0·080	2·79 × 2·02.
Length of antennæ	0·015	0·38.

Large, oval, dusky green, body-rings well marked. Head fuscous. Antennæ very short. Legs dusky and very short. All the somites are garnished with from four to six white woolly patches. Tail none. Rostrum very short. The antennæ are only partially developed, and are composed only of four joints.

The generation which succeeds this is flatter and smaller; smooth, darkish green, and furnished with short cotton-like threads. The antennæ, though somewhat more developed, still only show four articulations. Eyes very small.

Pupa.

This has a longer form, and is of a pale greenish hue. Head, wing-cases, and legs, somewhat smoky. The sides of the abdomen and the last few rings have white mealy patches. Towards the tail this farinaceous matter appears in greatest abundance. The lateral edges also have similarly disposed white spots.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·300	7·62.
Size of body	0·110 × 0·040	2·79 × 1·01.
Length of antennæ	0·040	1·01.

Body wholly black, with irregular patches of mealy matter, which also powders the wings. Head small and round. Antennæ six-jointed, the third, fourth, and fifth being dissimilarly ringed, the sixth smooth and ending with a nail. Abdomen long-oval, smooth, cylindrical, and mealy. Legs short and black. Eyes moderately large and black. Wings with smoky membranes. All the veins are black. Cubitus and stigma smoky grey. The two oblique veins of the fore wings take their origin from almost the same point of the cubitus. The third vein does not touch the cubitus by one third of its length. In the hind wings the oblique veins so unite to the costal nerve as to form a kind of trident. All the veins are black.

These winged females are very prolific, bringing forth oblong, smooth, yellow-coloured young, which appear like ova at the time of their birth. Six of these young were born and disengaged themselves from their enveloping membranes within the short space of an hour and a half.

I have gathered galls in plenty during the month of June, formed by swellings of the petioles of the leaves of *Populus nigra* and *P. dilatata*. They occur in many parts of England. I have picked them at Haslemere, Chichester, and Walthamstow. They are also common in the South of France, and at Spa in Belgium. These purses are pear-shaped or long-oval, with small openings at their summits, which gradually widen and have usually a number of pink corrugations at their edges.

Towards the beginning of July the winged females come out of their pupæ, and on the access of the sun's rays issue forth in great numbers in order to spread elsewhere. When cut into, these galls disclose a single chamber, formed of thick fleshy walls; which a high magnifying power shows to have a dense cellular structure. The cavities contain a quantity of those previously noticed spherical globules, which are of a mucilaginous nature.

Koch was aware that these habitations were the work of the stem-mother.

Notwithstanding the concealed life of these insects, they are by no means secure from the attacks of enemies. Minute *Aphidivorous Ichneumonidae* succeed in introducing their eggs, and the larvæ from these destroy the inhabitants and speedily cause the breaking up of the gall. After the galls are vacated they form a nidus for a small fungus which speedily converts them into dry dust.

M. Lichtenstein obligingly forwarded me in July excrescences from the Poplar, which rise from the more woody portion of the twig. Though constructed almost side by side with the pyriform galls, they differ much in form, being more spherical and rugose on their surfaces.

M. Lichtenstein, partly from these differences, hesitates to accept the pear-shaped construction as the work of *P. bursarius*. I am not aware that he has yet published any memoir on the specific differences of the insects fabricating these two descriptions of galls, but he suggests to me that the woody spherical gall is the work of *P. bursarius*, and that the pear-shaped excrescence is fabricated by an undescribed species, for which he proposes the name of *P. pyriformis*.

Réaumur gives a good woodcut of a sprig of poplar on which five galls are represented, two rising from the stem, two from the petioles of the leaves, and one from the midrib.* These he distinguishes in his description of the figure thus :—" La figure représente un bout de branche de peuplier chargé de plusieurs feuilles ; galles que partent des pédicules des feuilles (*P. pyriformis*, Licht.), autres galles qui tirent leur origine immédiatement de la tige (*P. bursarius*, Licht.), et une galle d'une feuille (*P. marsupialis*). " Réaumur groups these as the work of a single species, and I believe all authors up to the present time have similarly regarded the question.

* Réaumur, l. c., t. iii, pt. xxvi, fig. 8.

Kirby and Spence long ago spoke of "*Aphis bursaria*, which, with its brood, inhabits angular utriculi on the leaf-stalk of the black poplar, numbers of which I have observed on the trees by the roadside from Hull to Cottingham." Kaltenbach says, "Die Gallen sind an den verschiedenen Stellen auch verschieden gebildet." The following is the substance of his remarks on *P. bursarius*. The galls are differently constructed in different situations. The stem-mother which has survived the winter forms a swelling on the leaf-stalk (*Blatt-stiel*), which quickly rising on all sides forms a kind of groove in which the insect lies. The edges of this cavity draw themselves together over the creature, and at last wholly close her in. Sometimes two females work on the same foot-stalk, and their combined action modifies the form of the gall.* Koch gives two positions for the gall, one is constructed, he says, on the midrib of the leaf, and the other less frequently on the ends of the leaf-stalk; in these galls the openings are found at the sides: "Seltener bilden sich am Ende der Blatt-stiele solche Blasen." Passerini says:—"Intra gallas petioli et costæ foliorum *Populi nigrae*, Maio, Junio, et serius in gallis terminalibus ramuorum ejusdem speciei."†

I have compared the inhabitants of both galls, but although I see a difference in size of the insects, and a modification of the ringing of the fifth antennal joint, I do not feel competent to decide from these characters that they belong to different species. M. Lichtenstein's experience in these special genera will doubtless set the point at rest in one of the future papers he has promised on the *Pemphigians*. As the pseudo-gall itself is characteristic, I have figured it for the purpose of drawing the attention of British entomologists, yet still provisionally retaining it as constructed by *P. bursarius*.

* Kalt., 'Mon. der Pflanzenlause, p. 183.

† Pass., 'Aphid. Italicæ,' p. 75.

Koch's* figures of *P. bursarius* are not happy. Their wing-veining is inexact and defective in drawing.

M. Derbés,† and likewise M. Lichtenstein,‡ consider that two years are necessary to produce the complete evolution of the elm-feeding *Pemphiginae*. The last author, in conjunction with M. Courchet, has experimented with insects confined under glass cylinders containing grasses growing in moist earth. Up to the present time I believe they have failed to prove their descent to the roots and hibernation thereon. No doubt the artificial conditions rendered necessary by the experiment must present difficulties, but nevertheless more proof is required before this subterranean habit, connected with assimilation of such diverse food, can be accepted as more than an hypothesis.

It by no means appears that all *Pemphiginae* require two years for their complete cycle of life. The egg of some species is certainly consigned to the bark of the tree infested, where its vitality has been proved to resist very low temperatures. The warmth of returning spring is only required to bring the young into active life. It is remarkable, however, that the cold of late December will often find the winged females still vigorous, and delivering themselves of the true sexes under the protecting bark.

This oviposition under the bark has been confirmed by the researches of Messrs. Riley and Monell, who, moreover, think it improbable that any of the species so entirely change their habit as suddenly to feed on such dissimilar food, and to become earth-inhabiters during the winter.§

In expressing my own hesitation to accept M. Lichtenstein's hypothesis, I will acknowledge that the comparative scarcity of species of these *Pemphiginae* in Britain has prevented me from studying them with

* Koch, 'Du Pflanz. Aphiden,' p. 293.

† Derbés, 'Ann. des Science,' l. c.

‡ Vide Lichtenstein, 'Bull. Soc. Ent. de Fr.' (5), iv, 241—242.

§ Riley and Monell, 'Notes on the Aphididae of the U. S. of America,' Washington, 1879.

the same assiduity as he has done. In many particulars he can speak with more authority on a group which he has made his speciality.

PEMPHIGUS SPIROTHECÆ, Koch. Plate CXI, figs. 8—9 ; and Plate CXII, figs. 1—6.

Pemphigus affinis, Koch.

Pemphigus spirothecæ, Pass.

Puceron de peuplier, Réaumur.*

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·060 × 0·030	1·52 × 0·76.
Length of antennæ	0·030	0·76.

Elliptical, wholly pale green or yellowish; very lanuginous. Antennæ short, formed of four joints only; but a constriction of the third joint shows a tendency to develop another joint. Eyes very small; rostrum reaches to the second coxæ. The abdomen and legs clothed with cotton-like tufts.

I have never met with the winged form of *P. spirothecæ*, but Koch figures it apparently under the name *P. affinis*; and Passerini describes it as being very like the imago of *P. bursarius*. The fourth wing-nerve rises from a point scarcely beyond the half length of the stigma. The former species may be distinguished from the latter by the abundance of woolly matter which clothes the apterous form of *P. spirothecæ*.

The covered dwelling of this species is formed by the Queen Aphis, by puncturing one side of the leaf-stalk of the poplar, most usually that of *Populus nigra*. This irritation causes the stalk to flatten and curve itself into an elastic spiral, the edges of which press against each other, so as to form a chamber, in which the species multiplies and undergoes pupation.

* 'Mem. des Insectes,' t. iii, pl. 28, figs. 1—4.

The more normal forms are represented by the figures 1, 2, and 3, Plate CXII; but in the previous plate a gall is depicted which departs much from the usual shape. The insects taken from it, however, so well accord with Koch's and Passerini's description of *P. spirothecæ*, that I conclude the structure to be the work of that species.

I have compared the British insects also with those sent to me from the South of France, with which they well agree.

M. Lichtenstein found these coils still tenanted by winged females in December. He informs me that he kept some of these in confinement at Cannes during the winter of 1878, and that from them he bred non-rostrated males and females. In another letter he informed me that he had secured an egg from which in the May following he hatched a female. He placed her on a suitable tree in his garden and almost immediately she commenced her operations for constructing a gall, or its representative. Here she bred her young, and later in the year these assumed wings.

Through the kindness of this naturalist I am enabled to figure the oviparous female with her included egg, and likewise the diminutive male. Both of these are mouthless. The antennæ of the former are very simple in structure, and consist of only four articulations. The latter insect shows the recurved male organ. The sizes of these sexes are, for the former, 0·02 inch, 0·5 mm., for the latter, 0·013 inch, 0·3 mm. They were captured in December.

Dr. F. Löw, of Vienna, also experimented with these Aphides, and confirmed the observation that the produce of the winged female is mouthless, and that both sexes eventually descend into the ground for hibernation; a circumstance quite in accordance with Passerini's supposition that such might prove to be their habit. The egg probably is consigned to a crevice in the bark of the Poplar, from which the foundress of the new colony emerges in the spring.

Réaumur gives a spirited woodcut of a coiled gall on the poplar; and one cannot doubt that it was the work of *Pemphigus spirothecæ*.

Koch's description of the distorted leaf-stalks as "Stöpselzieherartig gewindene Beulen" (corkscrew-twisted bladders), clearly identifies his *P. affinis* with Passerini's *P. spirothecæ*. The diagnosis of the insects also well suits both. Koch says the fourth antennal joint is much shorter than the two following, and that whilst the species is intimately allied with *P. bursarius*, it is nevertheless smaller and woolly. *P. affinis* of Kaltenbach is a large insect, and, as Passerini remarks, is not identical with Koch's *P. affinis*. Except that the last specific name is preoccupied, priority should be given to that of Koch, who first clearly described the insect.

Koch's figure represents the insect covered with long hair instead of flocks of cotton; a defect likely to mislead the searcher.

This species has not been, hitherto, recorded as British. Probably it is nowhere plentiful in this country.

PEMPHIGUS LACTUCARIUS, Pass. Plate CXII, figs. 7—13.

Amycla fuscicornis, Koch.

Apterous viviparous female.

	Inch.	Millimètres.
Size of body	0·080 × 0·045	2·02 × 1·13.
Length of antennæ	0·020	0·50.

Oval, pale yellow, mealy, with an abundance of long, waxy, silk-like fibres, which proceed more particularly from the anal rings. Early in the year these insects are quite blind, but in the autumn they show obvious eyes, though very small. Antennæ short and fuscous towards the tips. Tail and nectaries none. Antennæ, legs, and a squarish spot on the occiput sooty grey.

Abdomen pale, with two rows of minute lateral dots. Rostrum reaches to the second coxae. The antennal joints vary in number according to the size of the individual.

The young which are born in the early year are linear and nearly cylindrical. They have much the appearance of young centipedes, which are pretty constant companions of this and other underground species of *Aphis*. These young have only four antennal joints, which increase to five, not counting the nail, as they pass into more mature forms. Except that these young show a short rostrum, they might be taken for miniature Juli.

Koch saw these abnormal forms born, the adults having been placed by him between watch-glasses. Like this naturalist, I have not met with the imago. Nevertheless, I have no doubt that my insect is identical with *P. lactucarius* of Passerini. The diagnosis, habitat, and food well agree. The last author describes the winged female as a true *Pemphigian*, and also states that the pupa is lanuginose.

This insect is plentiful in some light and sandy soils, which they excavate in the vicinity of the roots of various plants, such as *Lactuca sativa*, *L. virosa*, *Sonchus oleraceus*. The *Aphis* is very plentiful at Haslemere, where I found them at the roots of the wall-flower (*Cheiranthus Cheiri*), the fetid chamomile (*Anthemis cotula*), and the goose-foot (*Chenopodium album*). But they are most common at the decaying roots of the garden lettuce, few of which, in January and February, can be uprooted without showing their downy flocks.

The communities inhabiting these earth cavities are not large. They do not usually number more than eight or a dozen individuals, which become darker in colour after exposure to the air. This they seem to shun, for they speedily re-bury themselves after being unearthed.

Towards the middle of September, after the corn

had been cut some weeks, I found *P. lactucarius* very abundant at the roots of the wheat stubble. These apterous insects were full of embryos, ready for extrusion. Although Persicaria and other weeds were in the neighbourhood, the roots of which I carefully searched, I could find no Aphides of other species. *Siphonophora granaria* is such a common corn pest that I thought some underground form might possibly present itself, to explain the total disappearance of the insect at the gathering in of the crops. However, nothing discovered led me to believe in such an underground habit of *S. granaria*. The different winged forms of course precluded all likelihood of any connection between this *Aphis* infesting the ear and the *Pemphigus* nesting at the root of the wheat.

Specimens of these last were kept in moist earth under a bell glass for many days, but I failed in procuring either imagos or pupæ from them.

The large females are well suited for showing the fine net-work of tracheæ which ramifies throughout the body. These air-tubes may be readily separated by teasing with fine needles, after the insect has been placed in syrup or a weak solution of salt, to prevent the breaking-up of the delicate tissues.

It is not easy to see why Koch separated this and the preceding *P. fuscifrons* from the genus *Pemphigus*. His genus *Amycla* seems to depend on characters too indefinite and variable to allow of certainty. He seems to rely chiefly on slight variations of length in the antennæ and rostra in the three species he describes in his genus.

PEMPHIGUS PALLIDUS, *Haliday*. Plate CXIII, figs. 1—5.

Eriosoma pallida, Haliday : Curtis.*

Pemphigus albus, Licht.

„ *ulmi*, Licht.?

Apterous viviparous female. Queen Aphis.

	Inch.	Millimètres.
Size of body	0·110 × 0·070	2·79 × 1·77.
Length of antennæ	0·025	0·62.

Large, oval, white or pale yellow, which by age turns browner. Antennæ five-jointed. Eyes very small, almost obsolete. Legs and antennæ rather fuscous. Hind legs much longer than the other four. The members of the first brood are much smaller than the insects which issue from the egg; they are of a ferruginous pale yellow.

Pupa.

Long-oval, yellow, with pale wing-covers. Eyes red. Abdomen greyish.

	Inch.
Size	0·070 × 0·035.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·220	5·58.
Size of body	0·080 × 0·035	2·02 × 0·88.
Length of antennæ	0·020	0·50.

Variable in size. Head and thorax bluish-black. Abdomen oval, yellowish, with fine lateral dots. Eyes red. Legs and antennæ fuscous. Wings moderately long. Veining fine and pale brown. Stigma greenish. The hind wings, like other *Pemphiginae*, have two oblique veins. Notwithstanding the similar woody character of the two galls, both of which are formed without foot-stalks on the midrib of the leaf of the elm, the above-described insect probably is not that called by Ratzeburg *Tetraneura alba*, which seems also

* Curtis, App. 279.

to be that of Kessler and Löw. That genus necessitates the presence of one single oblique vein in the lower wing. All the specimens I possess show two oblique veins, which I look upon as constant.

M. Derbès, in 1868, described an insect which feeds on *Pistacio terebinthum*, to which he gave the name *Pemphigus pallidus*, but this manifestly is quite a different species from this on the elm tree.*

As Haliday published his researches in 1839, priority should be given to the name he gave his insect, and accordingly I retain it.

Haliday's description of *Eriosoma pallida* is as follows :—“ It inhabits the mountain-elm. Its follicles are more solid and embedded in the leaves, near the base of the midrib, not elevated on a foot-stalk, . . . than in *Eriosoma ulmi gallarum*. The apterous female of *E. pallida* is white. The follicles burst about the beginning of August. The society then is very numerous, and the farinose secretion more abundant than in that species.” He then describes the winged form and says, “ the nerves of the upper wing are nearly as in *E. ulmi gallarum* (*Tetraneura ulmi*), but the lower have two nervures (in the place of one) springing from the sub-costal. The joints of the antennæ also are of different proportion, the sixth being rather longer than the fifth.”†

PEMPHIGUS FILAGINIS, *Fonsc.*, *Pass.* Plate CXIV, figs. 1—4.

Aphis filaginis, Boyer de Fonsc.

Pemphigus gnaphalii, Kalt., Walk., Hardy.

Apterous viviparous female.

	Inch.	Millimètres.
Size	0·080 × 0·050	2·02 × 1·27.

* M. Lichtenstein proposes, in a letter to me, that, to avoid confusion, this insect should in future be called *Pemphigus Derbesi*.

† A. H. Haliday, ‘ Ann. Nat. Hist.’, vol. ii, p. 189.

Oval, pale yellowish-green or dark grey, thickly covered with a white powder. Antennæ and eyes black. Legs yellow and moderately long. Tarsi and tips of tibiæ black. Rostrum reaches to the second coxae.

Winged viviparous female.

	Inch.	Millimètres.
Expanse of wings	0·230	5·84.
Size of body	0·080 \times 0·030	2·02 \times 0·76.
Length of antennæ	0·020	0·50.

Head, thorax, and eyes dark brown or black. Third antennal joint slightly imbricated. Abdomen oval, yellowish-green or orange, powdered. Legs rather short and darkish yellow. Wings with membranes rather fuscous yellow. Insertions yellow. Stigma transparent, pale green, with a darker internal spot. Veins green and very fine. Stigmatic vein curved. Rostrum reaches to the second coxae.

Oviparous female.

Oblong, dull yellow. Eyes very small. Antennæ short and simple, the joints restricted to four. Legs very short. This sex is mouthless, the sucking organ being represented by two buccal plates.

Found hiding under the woolly flower-bunches of the cudweed *Gnaphalium germanicum*. The apterous forms some years ago were taken by Mr. J. Hardy as far north as Scotland. The insect seems to be more plentiful in France than in England.

In concluding this description of the British *Pemphiginae*, I believe M. Lichtenstein will allow me to add a short extract from a letter he addressed to me in 1877: as he has since in public expressed his views, I may be permitted to quote his words.

"The fact on which I claim the attention of my Entomological colleagues is, that the underground *Pemphiginae* (*P. Boyeri*, *P. caeruleascens*) lay pupæ,

giving sexuated forms, whilst the aerial *Pemphiginae* (*P. bursarius*, *P. affinis*, &c.) lay what I have called "œufs bourgeons," giving agamous insects with rostra, and having to change their skins four times before laying eggs (œufs bourgeons?). This leads me to believe that the underground insects are only a form of the aerial ones, and the principal as being the sexuated."

Again, in a communication more recently made to the Academy of Science of Montpellier, he details some experiments made to prove the identity of *Pemphigus filaginis* with *Pemphigus bursarius*. Experimentally he bred "thousands" of the former under a bell glass containing a living plant of *Gnaphalium* presumably free from *P. filaginis*, on which he purposely had placed specimens of *P. bursarius*. Subsequently, he has expressed his intention to hatch some eggs of *P. filaginis*,—which are exceedingly plentiful at Montpellier, to see if they will produce the "fundatrice" of *P. bursarius*. This experiment is the more necessary since it is exceedingly difficult to eliminate all germs of *P. filaginis* from such a woolly plant as *Gnaphalium*.

Shortly expressed, M. Lichtenstein thinks it probable at least, that the aerial *Pemphiginae* are dimorphic like *Phylloxera*. That the winged forms produce two kinds of agamous insects, one of which undergoes several moultings, and then produces the ordinary aerial males and females: the other agamous insect descends into the ground, and, after taking some such form as *Pemphigus Boyeri*, produces "pupæ" which do not moult. These finally give birth to the mouthless but otherwise perfect sexes as above.

Proofs are yet wanting, but Entomologists have much to hope from the perseverance and industry of M. Lichtenstein.

GENUS XXVII.—TETRANEURA,* *Hartig.*

GALLENLÄUS.

Rostrum in the adults very short.

Antennæ short, about equal to the head and thorax; six-jointed, the last joint ending with the usual button; the third joint much ringed.

Cornicles and tail entirely wanting.

Wings similar to those of *Pemphigus*, except that there is only one oblique vein in the hinder wing.

The stigma has a dark included spot.

Legs short, as in *Pemphigus*.

These insects live in small pedunculated pseudo-galls, which are usually constructed from the midrib of the Elm leaf. The mature insects perforate the side of the gall, which expands into a more or less irregular hole from which they find an exit.

There is but one British species belonging to this genus as yet recorded. M. Lichtenstein, however, sent me deep-red, hairy galls from the leaves of the Elm, which differed much from those made by the English insect. He proposes to call the French insects *Tetraneura rubra*. *Tetraneura alba* also is a Continental species, which has not been observed in England.

TETRANEURA ULMI, *De Geer.* Plate CXIV, figs. 5—13.

Aphis gallarum ulmi, De Geer, Geoff., Von Gleichen.
Tetraneura ulmi, Hartig, Kalt., Koch., Pass.

Apterous viviparous female. Queen Aphis.

	Inch.	Millimètres.
Size of body	0·085×0·055	2·14×1·39.
Length of antennæ	0·012	0·30.

* From τέτρα (pro τέταρτα), four, and νεύον, a nerve.

When full-grown; globular, very shining dark green, or nearly black after removal from the gall and exposure to the air. Antennæ very short and only four-jointed. Body furnished with a few fine hairs, but not clothed with any abundance of cottony fibre. Eyes small and black. Legs short.

Notwithstanding some risk of recapitulation (since the life-history of *Tetraneura* has much in common with that of *Pemphigus*), I append my own observations on this species, which accord with those of Dr. H. Kessler, of Cassel, and the American naturalists.

Early in the spring, minute, longish, black, shining, unwinged insects may be found close to the leaf-buds of our elms. They are about 0·010 of a millimètre long. These are the Queens of the colonies which are to appear through the year.

As soon as the young leaves unfold, these insects commence their irritating action, and the leaves then show, by the red spots on their under sides, that there is a diversion of the sap, causing a cupping of the edges of the rising blister, which finally arches over and encloses the growing *Aphis*.

So far as my observations go, the leaf is attacked not only at the midrib, but also in the spaces between the other leaf-veins. In all cases, however, the gall becomes pedunculated, and rises a considerable distance above the surface.

The size of these galls would seem very much to depend on the season and the luxuriance of growth of the trees. German specimens* are described as either round or of an oval form, the long diameter being about one centimètre; but I have certainly in England seen them larger than three eighths of an inch.

In the neighbourhood of Cassel they are described as studding the trees occasionally in such masses, that they bow down the points of the branches.

* For more minute particulars the reader is referred to Dr. Kessler's 'Die Lebensgeschichte der auf *Ulmus campestris* vorkommenden Aphiden-Arten,' &c., and M. L. Courchet's 'Etude sur les Galles produits par les Aphidiens,' 1879.

What takes place within these closed chambers can only be surmised ; but from the cell-walls the solitary *Aphis* gets her nourishment, and within them she undergoes four moults (Riley and Kessler). After these have been completed, she commences reproduction. The young vary much in number, but are all blackish, with paler undersides; their hinder parts are furnished with a white woolly coat, mostly proceeding from the last body-rings. After the first moult they become greener.

Throughout the summer of 1879 this species was common on most of the elms at Old Romney in Kent. They seemed, however, mostly to affect the leaves of *Ulmus suberosa*.

The galls, when slit open early in June, showed that they were still tenanted only by the Queen *Aphis*, who had not completed her moults, for no exuviae could be found. At this time the same trees were tenanted by the leaf-rolling *Schizoneura ulmi*, which were much more advanced, and were commencing to migrate.

The progeny of the second generation numbers forty or more, and after a while gives rise to the pupæ, which again in due time disclose the winged females, just as in *Pemphigus*. These imagos issue from the pseudo-galls at different intervals, but the population of the gall is kept up pretty constantly throughout the summer by the Queen *Aphis*.

Winged viriparous female.

	Inch.	Millimètres.
Expanse of wings	0·240	6·09.
Size of body	0·080 \times 0·030	2·02 \times 0·76.
Length of antennæ	0·025	0·62.

Head and thorax black and naked. Abdomen long oval, dark green or olive. Slightly powdered. Antennæ very short; third and fifth joints ringed. Nectaries and tail wanting. Wing-membranes smoky.

Cubitus, stigma, and wing-veins brownish. Hind wing with a single oblique vein.*

Oviparous female.

Size . . . 0·027×0·020 mm.

Very small, globular. Antennæ only partially developed, and composed of four joints. Rostrum none. Eyes minute, and showing but seven or eight facets. Legs short. The abdomen is occupied almost exclusively by one large egg; indeed, this insect may be regarded as little more than a walking seed, which is capable of choosing its own place for deposit.

The *first* winged forms issue from the galls about the last week in June. One of these, captured whilst flying, appeared like a small fleck of white down. It was placed under a watch-glass for after examination; but during the night she produced upwards of thirty young ones, all of which possessed remarkably long rostra, which trailed behind them whilst walking. One of these insects is represented in Plate CXIV, fig 10.

On cutting open a pedunculated gall, on June the 11th, the single *Aphis* was turned out. She was pale green, with a brown head, legs, and eyes. Two moulted skins were found at the end of the gall, together with an abundance of woolly matter. This Queen-mother was perpetually engaged in wriggling from side to side, and pricking the inside of the gall with her rostrum.

The leaves viewed from the underside show oblong orifices or slits at the junction of the peduncle. These ventilating slits are partially closed by a dense fringe of jointed threads, which doubtless prevents the entrance of many a prying parasite. The cells were full of winged insects on the 20th of July.

* I have captured winged females having not more than one third of the above measurements. Probably these were of the second series, which occurs in autumn.

Although the galls in England take several forms, I am not disposed to multiply species on this account.

Some structures have two peduncles, some have two orifices, some spring from the midrib, whilst others rise from the green fleshy portion of the leaf. All these show a purple colouring at their apices.

The genus *Toxoptera* was formed by Koch to receive some insects which are somewhat anomalous, inasmuch as they combine the characters of *Myzus* and, as far as the wing-veining goes, of *Pemphigus*.

Two species are known of this genus, viz. *Toxoptera aurantiae*, Koch, and *T. graminum*, Rondani. The former is common on the Orange, the Citron, and the Camelia in Germany, South France, and Italy; but, as these trees are exotics here, this *Aphis* cannot be regarded as indigenous to Great Britain. *Toxoptera graminum*, during the summer, is an inhabitant of various Grasses, affecting the lower leaves, and numerously so. *Triticum*, *Hordeum*, *Avena*, *Sorghum*, and *Zea* are habitats of this species.

The characters of *Toxoptera* are: Antennæ seven-jointed, and placed on small remote frontal tubercles. Cornicles and tail moderately long. Wings with the cubital vein but once-forked. The rest of the characters as in *Myzus*.

Rondani says that in the year 1852 the streets of Bologna were swarming with innumerable troops ("turmis innumeris") of *T. graminum* to the annoyance of the inhabitants. "Urbis nostræ vias cadavera hujus formæ primo mane velabant."* I suppose a little exaggeration may be allowed to an enthusiast.

Sir Joseph Hooker kindly made several searches for this *Aphis* in the orangery of the Royal Botanical Gardens at Kew, and Sir Charles Isham also made examinations of the plants in his fine camelia house at Lamport Hall.

In both cases the search was ineffectual.

* Rondani 'Ann. delle Scien. Nat. de Bologna.'

Although no species as yet has been recorded British, a passing notice of the genus is desirable, and may lead to its discovery amongst our Gramineæ.

Similar remarks will in a measure also apply to Passerini's genus *APLONEURA*. The single species known, *Aploneura lentisci*, inhabits follicles constructed on the leaves of *Pistacio lentiscus*. The chief character advanced for this genus seems to be the horizontal position assumed by the wings, when at rest. This insect is not known in Great Britain.

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ERRATUM.—Page 6, line 28, for apterous read apodous.

PLATE LXXXVII.

CALLIPTERUS BETULARIUS. (Page 14.)

Fig. 1.—Apterous viviparous female. The abdominal tubercles are tufted with capitate hairs.

Fig. 2.—Apterous oviparous female. The last three abdominal rings are dilated from the presence of an egg ready for extrusion.

Fig. 3.—Winged female, showing the great length of the antennæ.

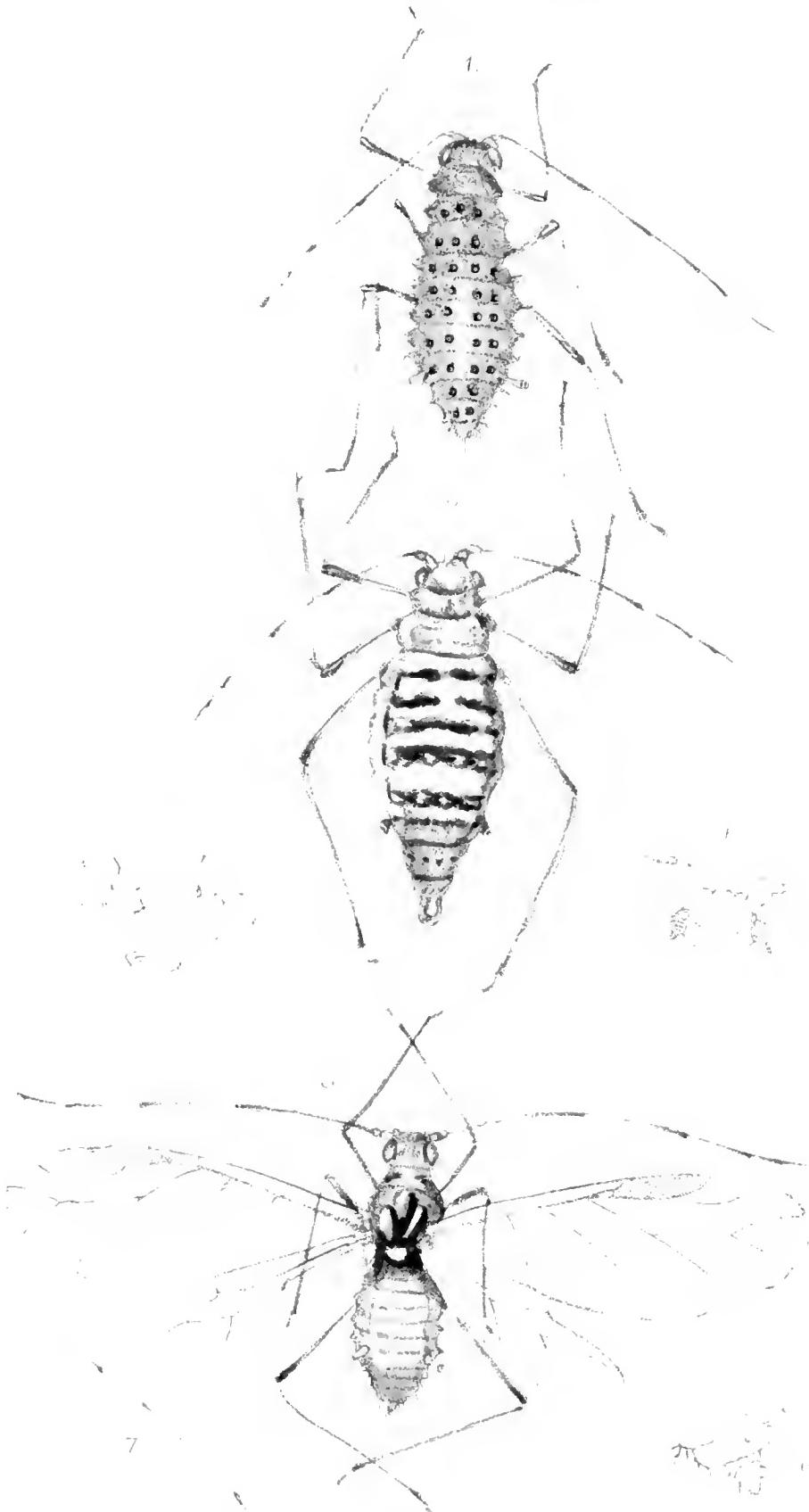
Fig. 4.—Head of the last insect, showing the stemmata and the two basal joints of the antennæ.

Fig. 5.—Trumpet-shaped cornicle of Fig. 2, with enlarged view of the capitate hairs, the summits of which have each a cavity similar to that shown in Plate XXII *bis*. These hairs probably are tactile organs.

Fig. 6.—Caudal appendage of Fig. 3.

Fig. 7.—Last three articulations of the antennæ of Fig. 3. The setaceous seventh joint is obvious.

PLATE LXXXVII



Calopteryx detrahens

PLATE LXXXVIII.

CALLIPTERUS BETULICOLA. (Page 15.)

Fig. 1.—Winged viviparous female. The body, antennæ, and legs are irregularly tufted with cotton-like matter. The length and delicacy of the wings may be noted.

Fig. 2.—Profile view of the apterous viviparous female.

Fig. 3.—Part of the antenna of Fig. 1.

CALLIPTERUS CORYLI. (Page 17.)

Fig. 4.—Apterous viviparous female.

Fig. 5.—Winged female. The wings are folded pent-wise, as is usual in *Aphis* when the insect is at rest.

Fig. 6.—Head and antennæ of the last insect.

Fig. 7.—Anal valves and nectaries of winged female. Similar appendages are visible, more or less markedly in all the species of this genus.



Callipterus betulincola 1-3
" *Coryli* 4-7

PLATE LXXXIX.

CALLIPTERUS CARPINI. (Page 19.)

Fig. 1.—The pupa.

Fig. 2.—Winged viviparous female evolved from Fig. 1.

Fig. 3.—Apterous oviparous female. The caudal rings are developed somewhat into the form of an ovipositor.

Fig. 4.—Apterous male, drawn of relative size to the last. Several examples were taken in company with Fig. 3.

Fig. 5.—Winged male. All specimens I have seen show a curved post-costal nervure, and they want the cloudy stains in the upper wings.

Fig. 6.—Head and antenna of winged male. This sex is rostrated.

Fig. 7.—Part of head and antenna of oviparous female.

Fig. 8.—Cornicle and caudal region of the pupa.

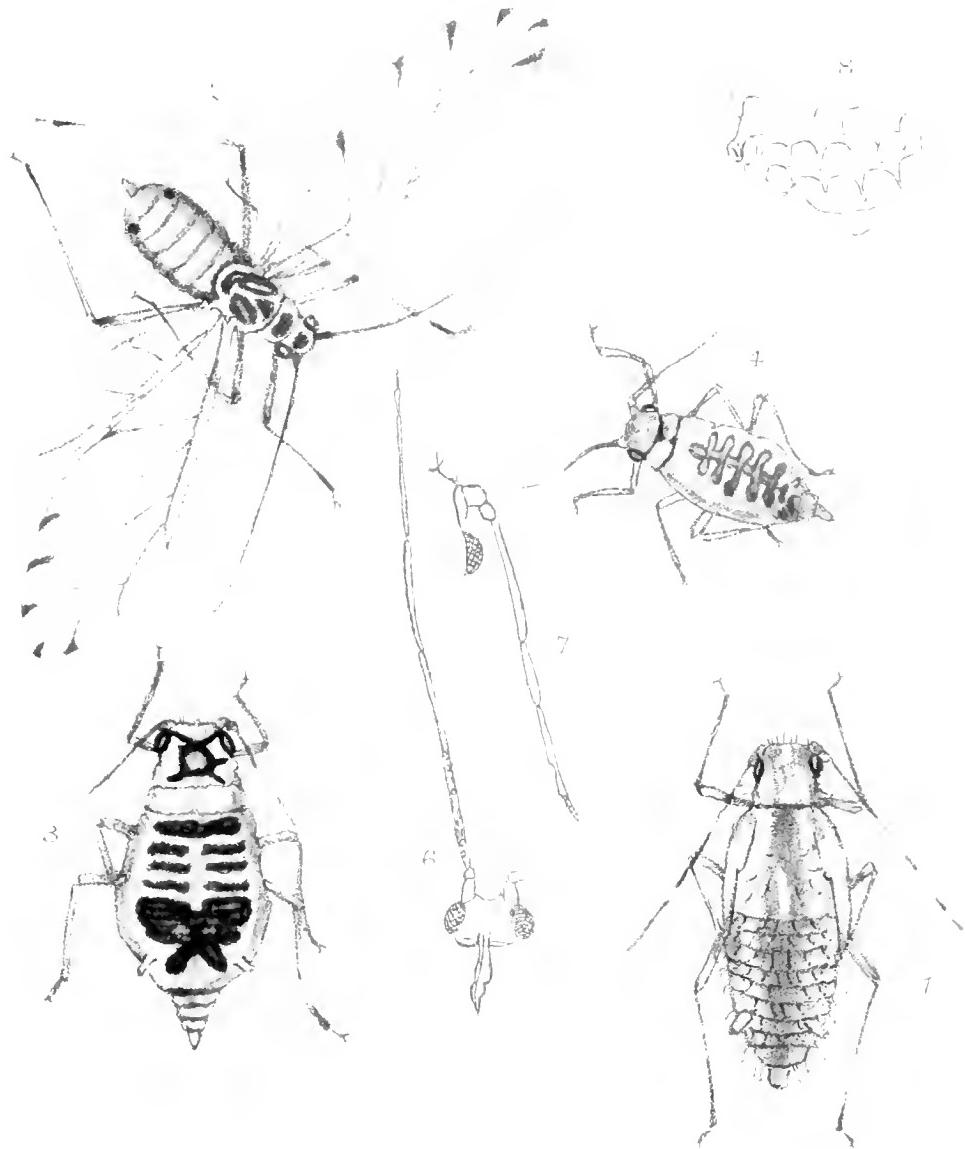
*Callipterus eupomi*

PLATE XC.

CALLIPTERUS QUERCUS. (Page 21.)

Fig. 1.—Apterous viviparous female.

Fig. 2.—Pupa of the same.

Fig. 3.—Oviparous female.

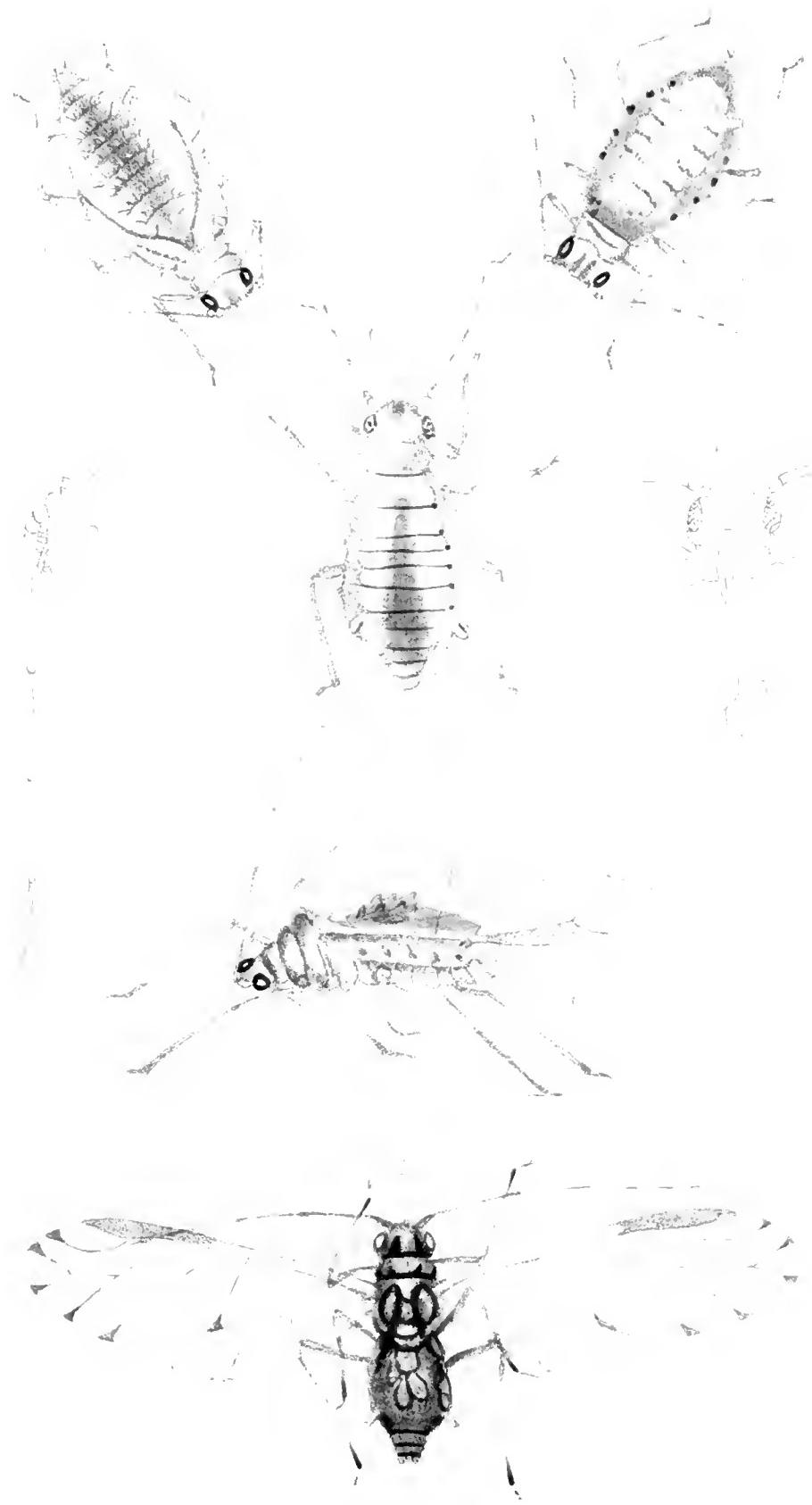
Fig. 4.—Profile view of the winged viviparous female, showing the six dorsal papillæ and the short rostrum characteristic of the genus.

Fig. 5.—Winged male. The wings and antennæ of this sex are relatively larger than those of the other forms.

Fig. 6.—Under side of the head and part of sternum of Fig. 5, showing the rostrum and first coxæ.

Fig. 7.—Cornicle of the oviparous female.

Fig. 8.—Part of the head and the antenna of the winged male.



Development of a fly

PLATE XCI.

CALLIPTERUS QUERCEUS. (Page 24.)

Fig. 1.—Apterous viviparous female.

Fig. 2.—Pale variety of the same, after moulting its skin.

Fig. 3.—Winged viviparous female. The short wings and the long body contrast much with the last species.

Fig. 4.—The winged male. Here the wings attain to a larger size.

CALLIPTERUS CASTANEÆ. (Page 26.)

Fig. 5.—Apterous viviparous female.

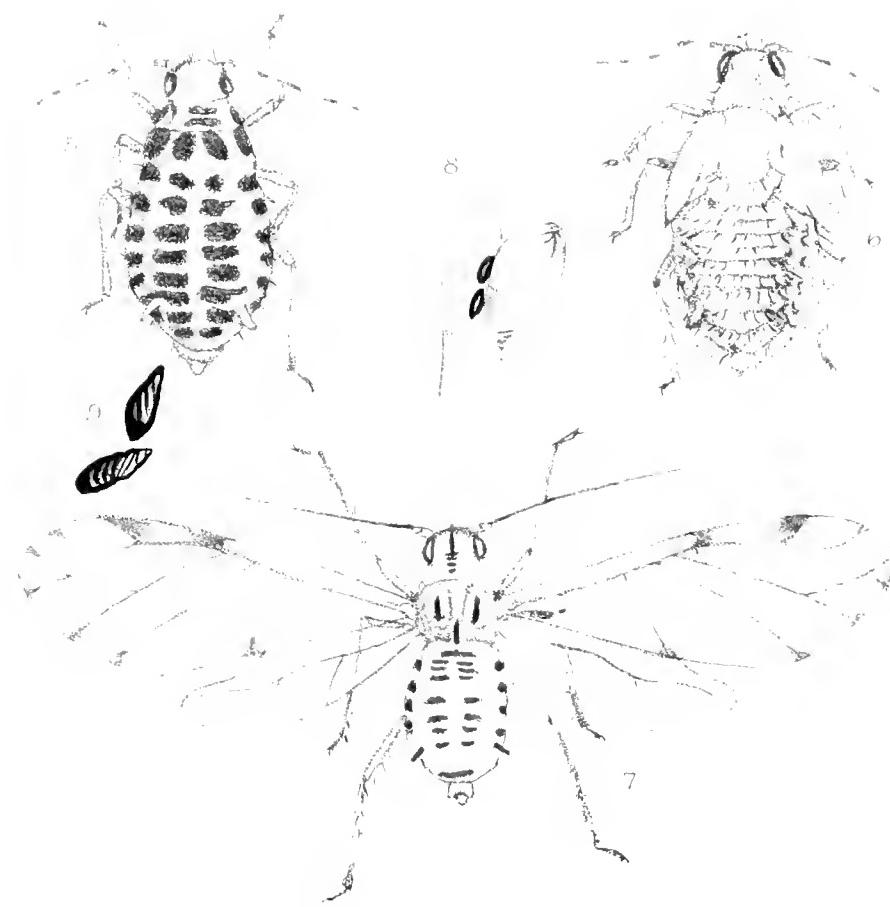
Fig. 6.—Pupa of the same.

Fig. 7.—Winged viviparous female. The anal valves are much developed in all the winged females of this genus. The disposition and number of the dorsal pigmental spots are variable.

Fig. 8.—A leaf-bud of the sweet chestnut (*Castanea vesca*), with two ova adhering, which will remain unhatched through the winter.

Fig. 9.—The ova magnified. Their form departs from the usual oval, being attenuated at one end.

PLATE 1



Callipterus quercus 1-4.
castaneus 5-9

PLATE XCII.

PTEROCALLIS ALNI. (Page 31.)

Fig. 1.—Apterous viviparous female.

Fig. 2.—Winged viviparous female.

Fig. 3.—Head and antenna of fig. 1. The front is setose.

Fig. 4.—Head of fig. 2. The front is smooth, and the smooth antennal joint curtailed in length.

PTEROCALLIS JUGLANDICOLA. (Page 32.)

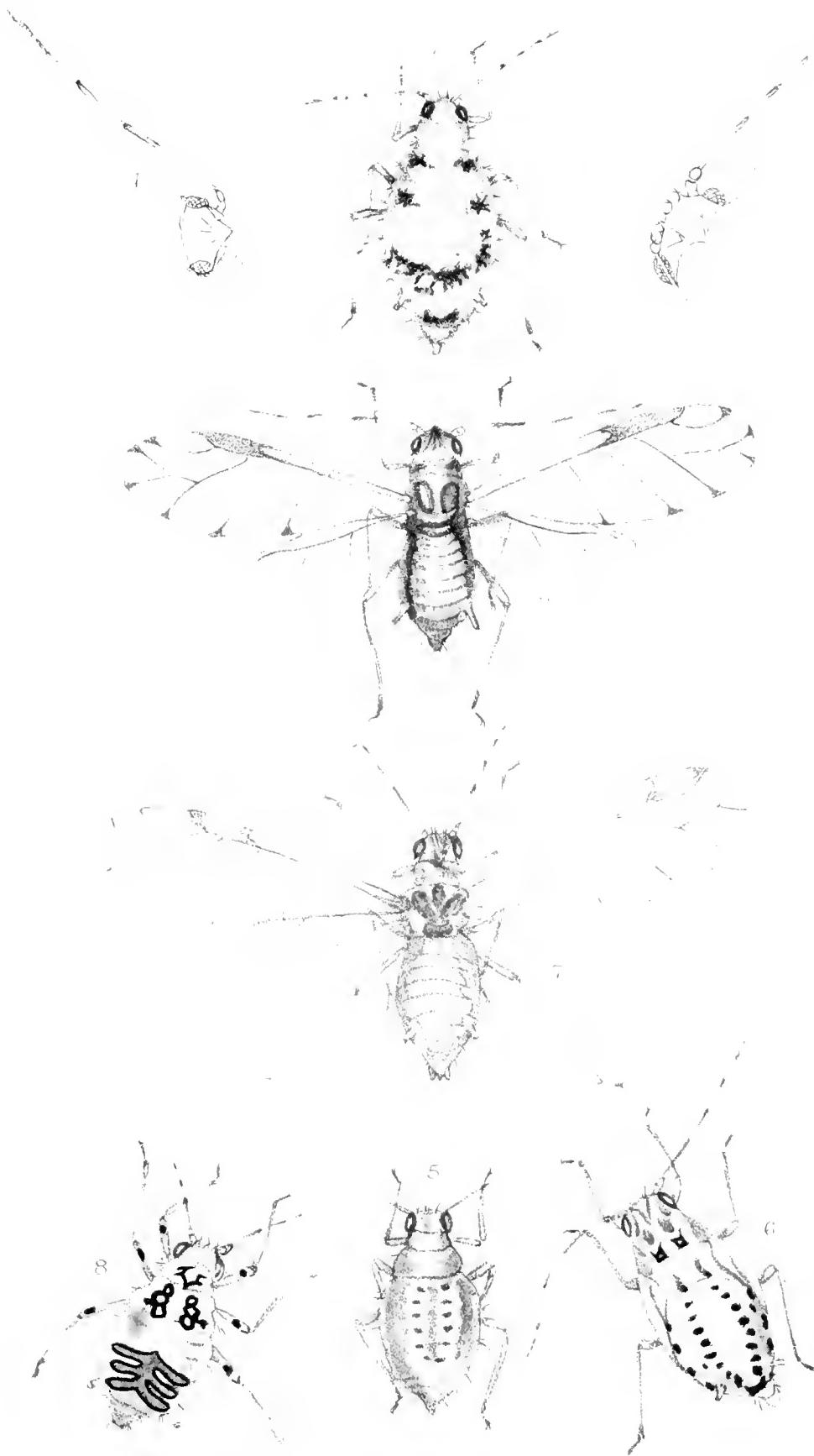
Fig. 5.—Apterous viviparous female.

Fig. 6.—Pupa of the same drawn of relative size.

Fig. 7.—Winged viviparous female.

Fig. 8.—Viviparous female. The isolated spots on the femora may be noted.

PLATE LXII.



Pheropsylla californica f.
anglandicola 5-8

PLATE XCIII.

PTEROCALLIS TILIÆ. (Page 34)

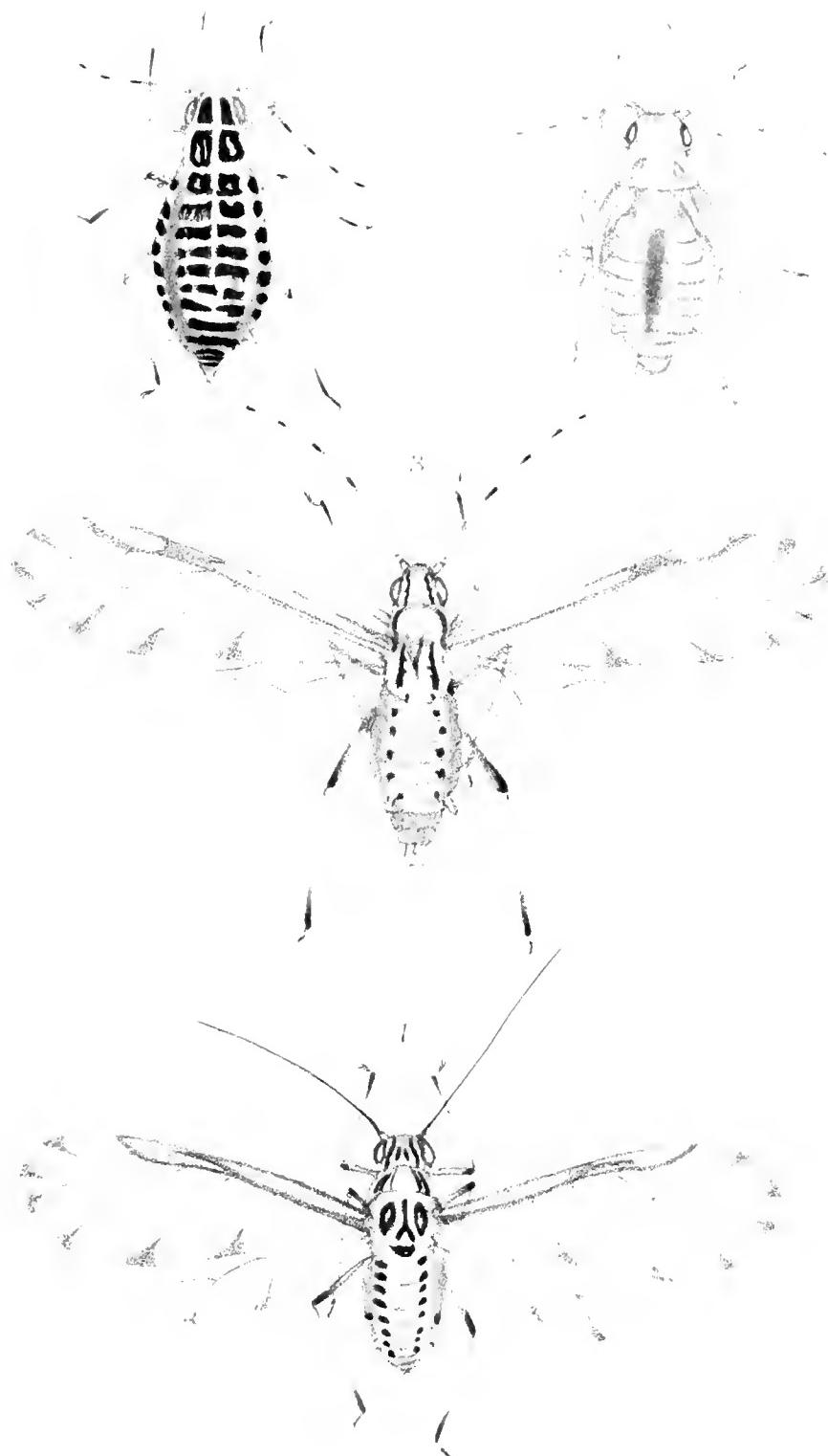
Fig. 1.—Apterous viviparous female.

Fig. 2.—Pupa of the same.

Fig. 3.—Winged viviparous female. The angular form of the post-costal nervure of the lower wing may be noted. The dark bands and spots in figs. 1 and 3 are inconstant.

Fig. 4.—Winged male. Perhaps the clouding on the wings is most marked in this example of the genus.

PLATE XCIII



Pterocallis tiliae

PLATE XCIV.

PHYLAPHIS FAGI. (Page 37.)

Fig. 1.—Apterous viviparous female enshrouded in long flocks of cotton-like substance.

Fig. 2.—The same insect denuded of this substance by treatment with ether.

Fig. 3.—The oviparous female appearing in October. The last rings are sparsely clothed with cotton, but not represented in this figure.

Fig. 4.—Winged viviparous female. This insect is both powdered and flecked with white filaments.

Fig. 5.—Apterous male, taken in company with fig. 3.

Figs. *a* and *b*.—Antennæ of apterous and alate viviparous females respectively.

Fig. *c*.—Head and short rostrum of imago (fig. 4).

PLATE XCIV.



Tryphosidae. Figs.

—

PLATE XCV.

PTYCHODES JUGLANDIS. (Page 40.)

Fig. 1.—Apterous viviparous female. The stout and short legs, and the cornicles, seen as mere pores, may be noted.

Fig. 2.—Winged viviparous female, the short antennæ and the narrow and peculiarly shaped wings are characteristic.

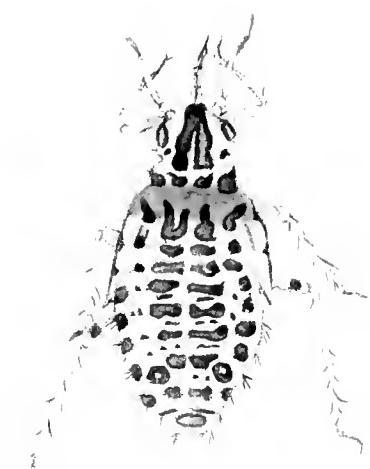
Fig. 3.—Broad head of the apterous female with its appendages. The three terminal antennal joints are noticeable.

Fig. 4.—The last abdominal somites, showing the short cauda (fig. *b*) and the two vaginal valves (figs. *a, c*).

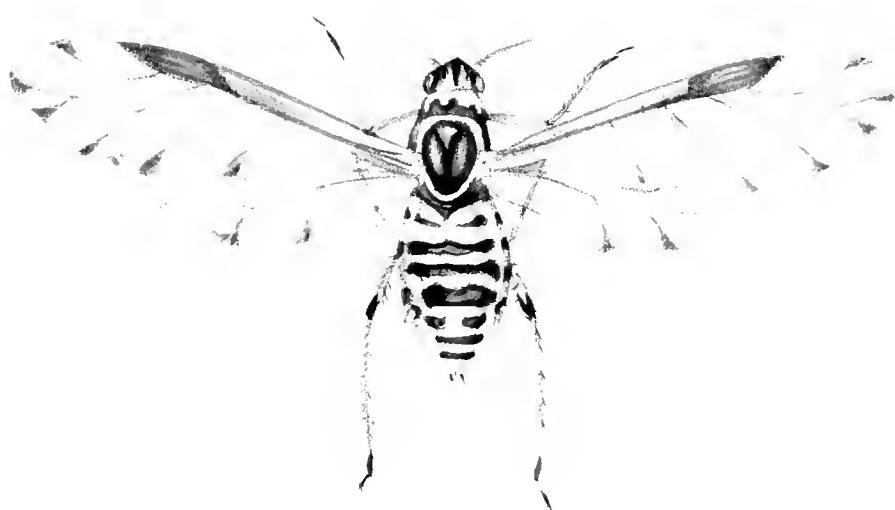
Fig. 5.—Cornicle of the imago seen in profile.

PLATE XCV

1



2



4



b

Ptychodes juglandis

3



5





PLATE XCVI.

LACHNUS JUNIPERI. (Page 44.)

Fig. 1.—Apterous viviparous female.

Fig. 2.—Imago of the same. *a.* The tarsus with the second joint more developed than in the foregoing genera. *b.* Cornicle or nectary seen in profile.

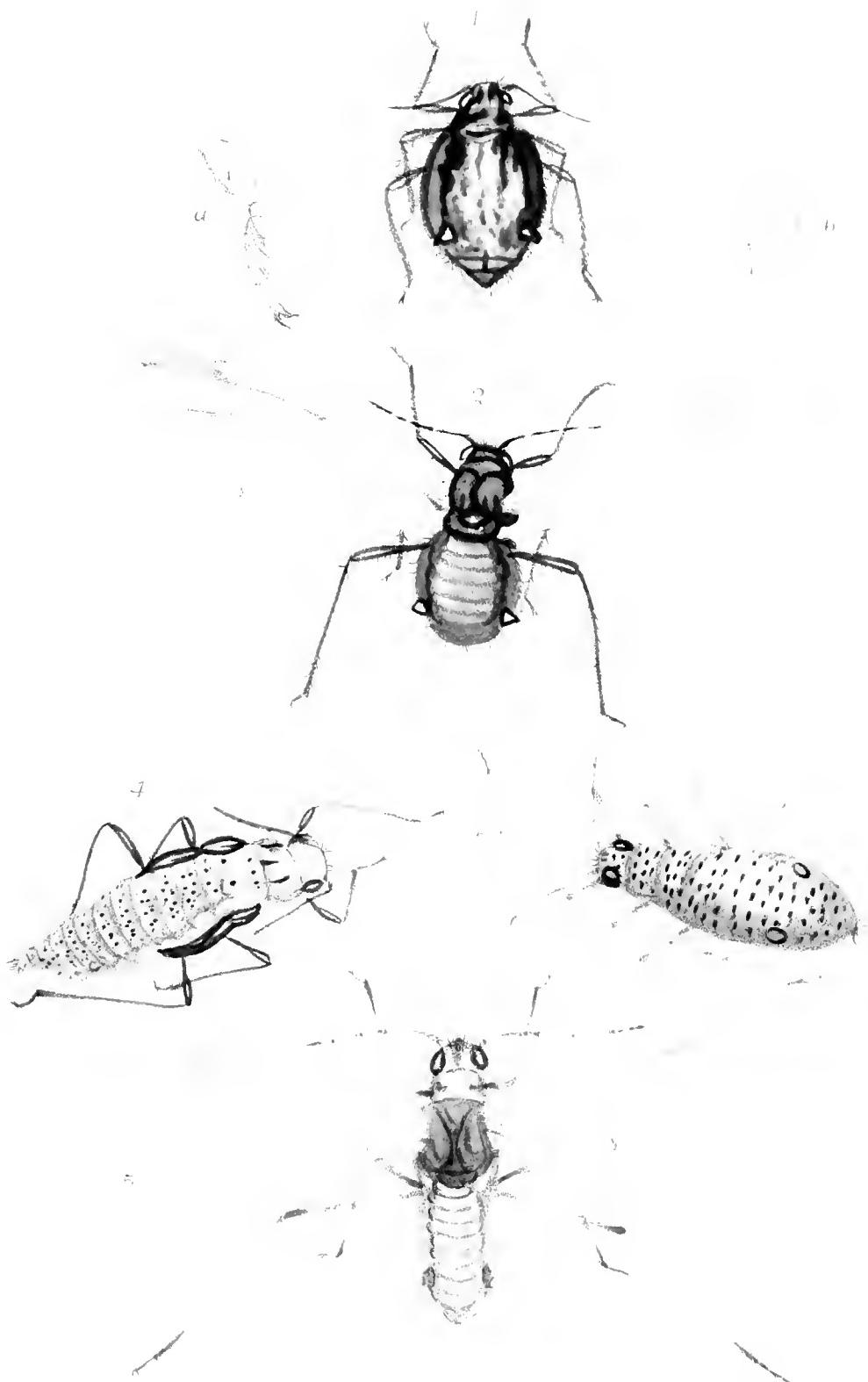
LACHNUS AGILIS. (Page 47.)

Fig. 3.—Apterous viviparous female.

Fig. 4.—Pupa.

Fig. 5.—Imago from the same. N.B.—The lineal form of this and the next species contrasts with the usual robust figure of other Lachninae.

PLATE ZCVI



Leuctra juniperi 1 - 2
3 - 4 - 5

T. Burk - Sch. Lab.

Westermann & Co.

PLATE XCVII.

LACHNUS MACROCEPHALUS. (Page 48.)

Fig. 1.—Pupa sparsely covered with white powder.

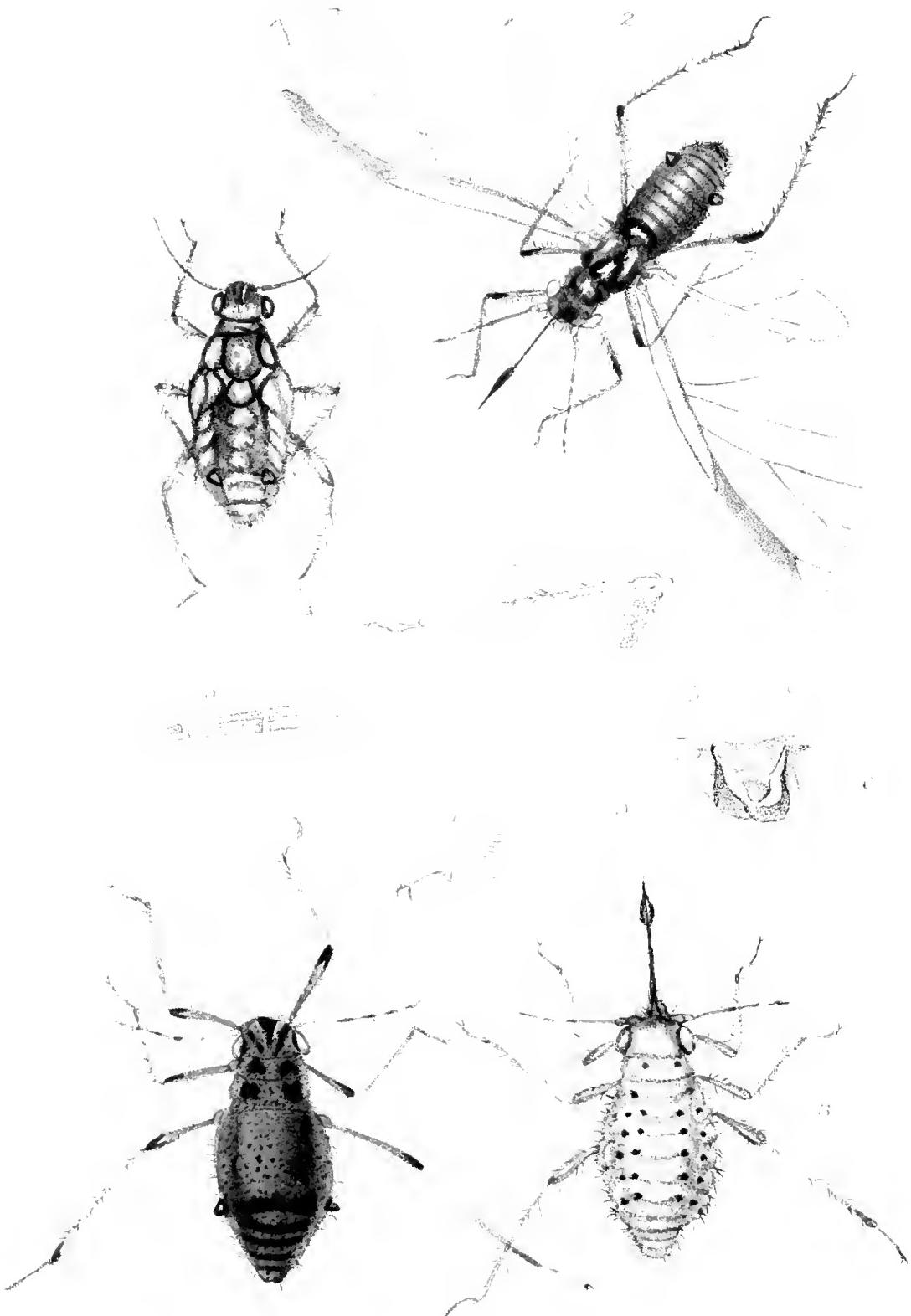
Fig. 2.—Imago with the protruded rostrum. The great length of the stigma is to be marked in all this genus. *a.* Head and antenna of imago. *b.* Last joints of the rostrum. *c.* Inverted view of the ano-genital rings. *e.* Exit of the false vagina. *f.* Valves closing the same. *g.* Clasping ring ("armature copulatrice"). A part of the tail is seen above. *d.* Tarsus with the second joint much developed.

LACHNUS PINI. (Page 50.)

Fig. 3.—Apterous viviparous female.

Fig. 4.—Dark variety of the same. The globule at the tail shows that the excretion of liquid is not, in these insects, confined to the nectaries.

PLATE XCVII.



Machimus macrocephalus 1-2.
3-4.

G. B. Finkton del.

n

pini

3 - 4.

West Virginia C. 1890

PLATE XCVIII.

LACHNUS PINICOLUS. (Page 52.)

Fig. 1.—Apterous viviparous female.

Fig. 2.—Winged viviparous female. The long stigma and the extended wings may be noted.

Fig. 3.—Young recently born from the imago.

Fig. 4.—Antenna of fig. 1. The tubercle (fig. *a*) preceding the “nail” at the end of the sixth joint is very usual.

Fig. 5.—Tarsus, with the hinged joint for the insertion of the retractile muscle, seen at *b*.

PLATE XCVII



Lachnus piniculus

PLATE XCIX.

LACHNUS VIMINALIS. (Page 53.)

Fig. 1.—Apterous viviparous female.

Fig. 2.—Pupa of the same.

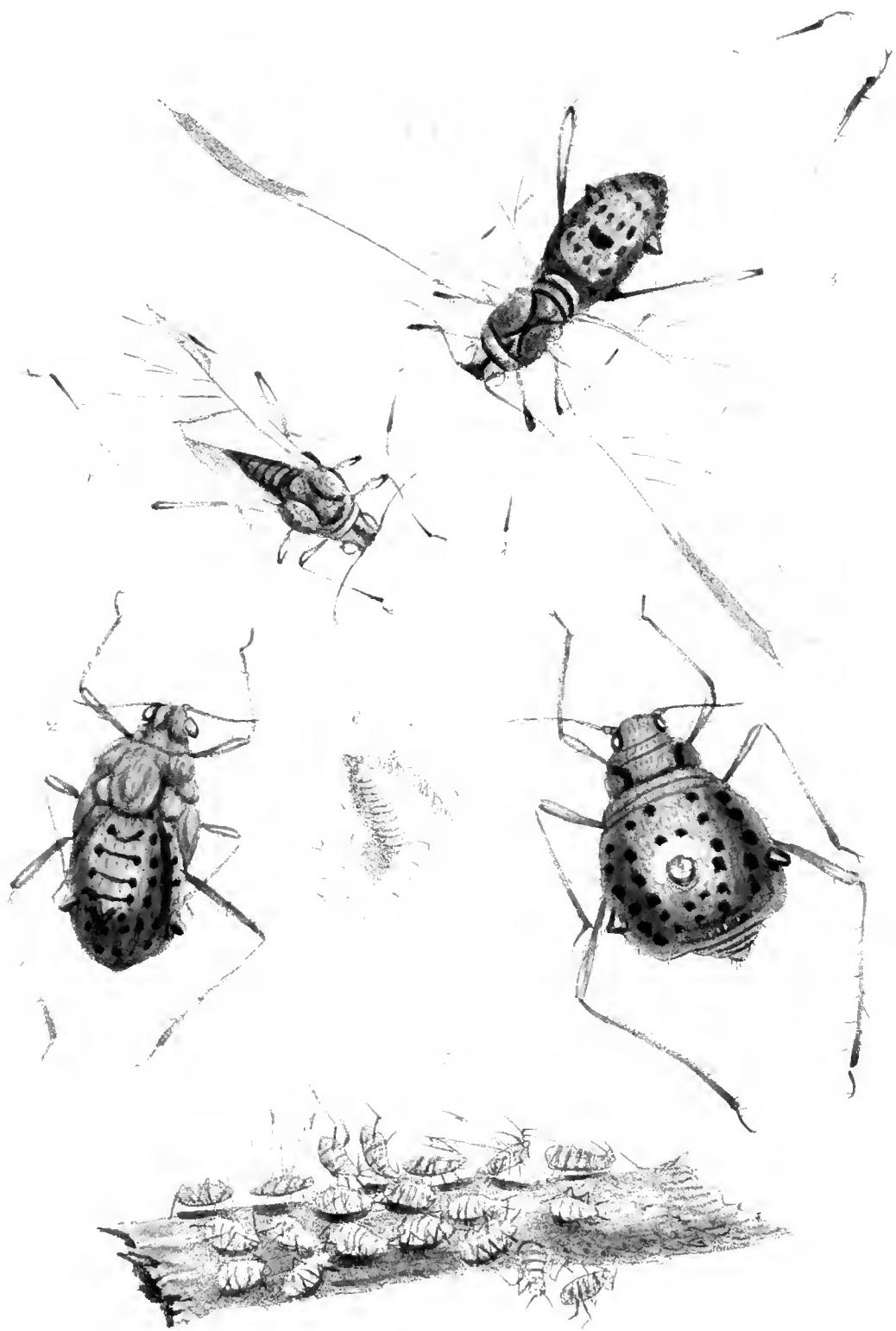
Fig. 3.—Imago. The tubercle seen between the cornicles in the previous forms is here wanting.

Fig. 4.—Imago, showing the wings folded horizontally whilst at rest. This position, however, is not always assumed by the wings.

Fig. 5.—A portion of willow bark infested by the above Aphis. Alarm is shown by the jerking upwards of the hind legs of the insects.

Fig. 6.—Dorsal papilla. The apex shows the orifices of minute vessels, which probably secrete some liquid, disgusting to the parasites which hover over the infested branches. The winged insects, by their activity, are less open to the attacks of Syrphus, Coryna, &c., and therefore they are not provided with this gland (?).

PLATE XII



Lachnus spp. imm.

PLATE C.

LACHNUS PICEÆ. (Page 58.)

Fig. 1.—Apterous viviparous female. *a.* The long rostrum *in situ*.

Fig. 2.—The rostrum much magnified, with details of the antennæ. *b.* The sheath with its very long setæ. *c.* The labrum.

Fig. 3.—The sixth and part of the fifth antennal joints. *d* represents the tubercular rings much magnified. Suggestions as to the functions of these drum-like orifices may be found on page 13, vol. i, of this Monograph.

Fig. 4.—Enlarged view of a sprig of the spruce fir, crowded with the polished eggs of the above Aphis.

*Lachnus piecae.*

PLATE CI.

LACHNUS LONGIPES. (Page 59.)

Fig. 1.—Winged viviparous female. Perhaps this insect has the greatest expanse of wing of all the British Aphididæ. The antennæ, on the other hand, are very short.

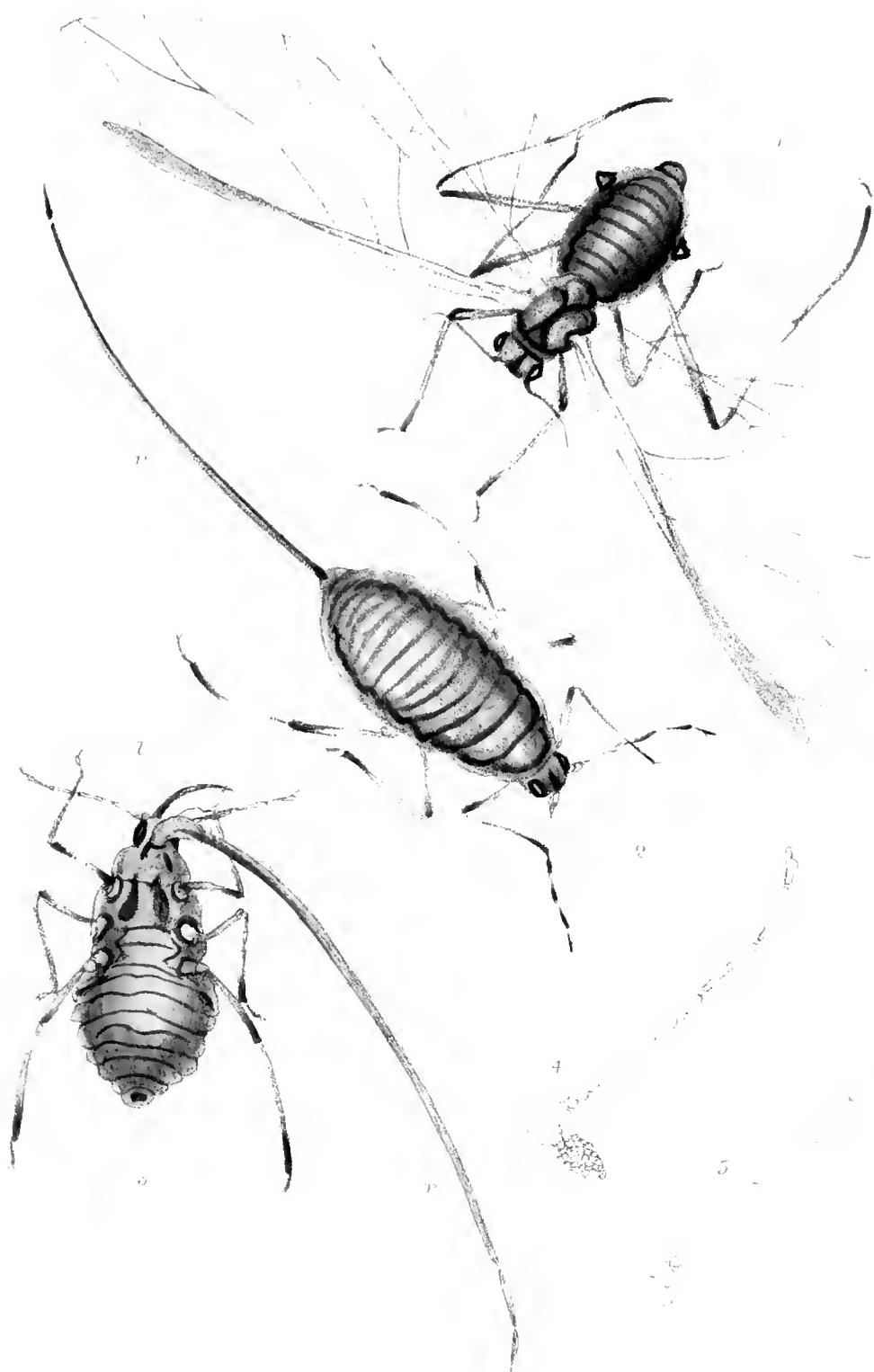
STOMAPHIS QUERCÙS. (Page 62.)

Fig. 2.—Apterous viviparous female. *r.* The rostrum protruding beyond the apex of the body.

Fig. 3.—The same viewed from the underside. The great strength of the sheath near the head is here shown. *i.* Labrum and the fine setæ. These last are the representatives of the labium and the maxillæ.

Fig. 4.—Head and antenna of fig. 1.

Fig. 5.—Head and antenna of fig. 2.



Figures 1-3. *Phyllocoptes* sp. (Acarina: Eriophyidae) from *Prunus* sp. (Rosaceae).
1. Dorsal view; 2. Ventral view; 3. Lateral view.

PLATE CII.

LACHNUS CUPRESSI. (Page 46.)

Fig. 1.—Apterous viviparous female.

Fig. 2.—Pupa from the same.

Fig. 3.—Imago. *a.* Cornicle of fig. 3 with bristles surrounding its base. *b.* The same viewed from above, showing the mouth of the nectary, which is capable of being closed by a contraction of the external lips. These figures are unavoidably somewhat out of their proper sequence. *Lachnus cupressi* is more nearly allied to *Lachnus juniperi*.

PARACLETUS CIMICIFORMIS. (Page 67.)

Fig. 4.—Apterous viviparous female. *c.* Head.
d. Antennæ.

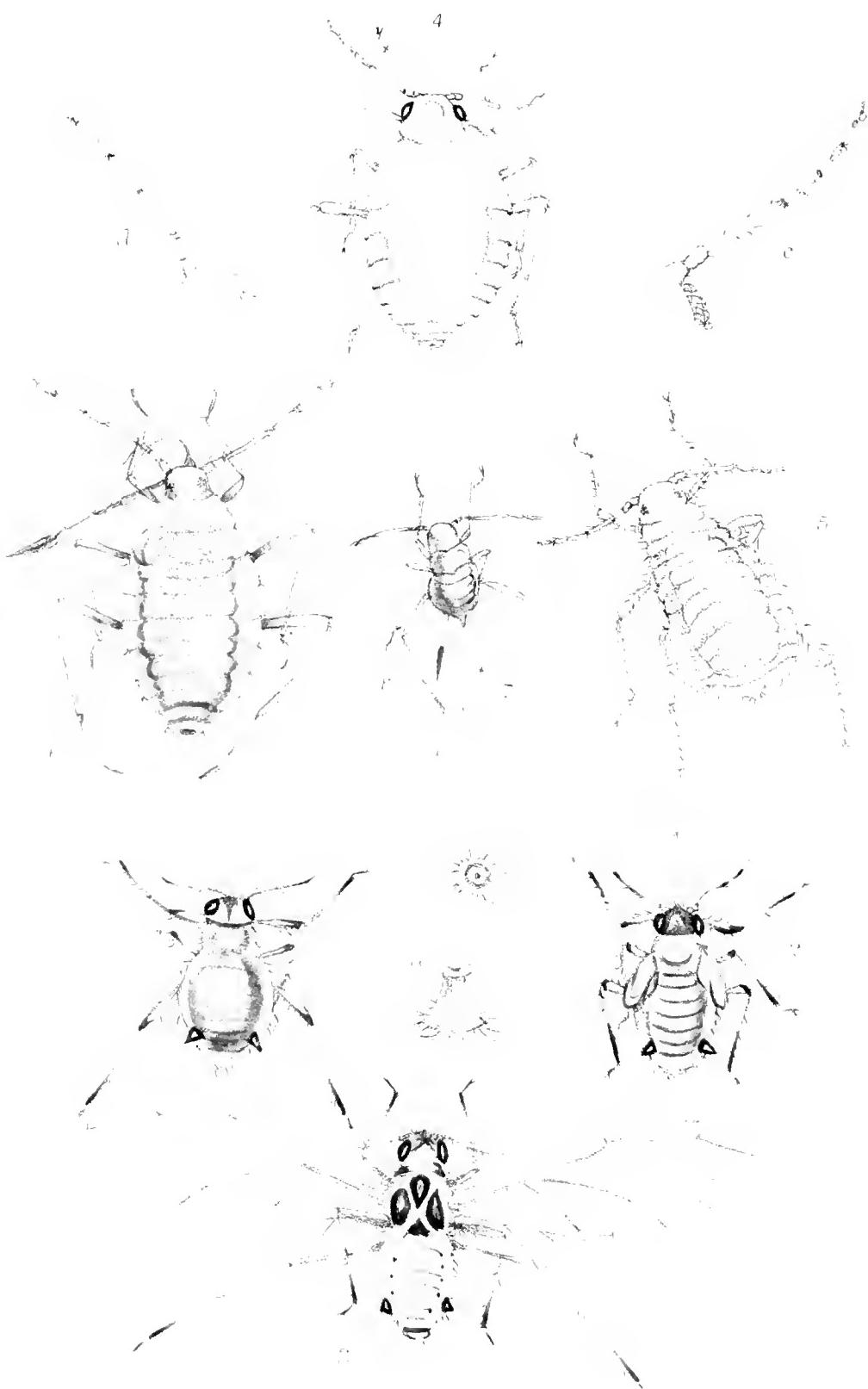
TRAMA TROGLODYTES. (Page 68.)

Fig. 5.—Apterous viviparous female. The pale hairy variety.

Fig. 6.—The same before a moult. The stout rostrum is represented at *r*. Notice may be taken of the characteristic *single-jointed* tarsus, which has a considerable length.

Fig. 7.—Young born from fig. 6. At this age the rostrum much exceeds the length of the body.

PLATE CH.



Lachnus sp. n. sp. 1-3
Paradelus emarginatus 4
Trematoglyptes 5-7

PLATE CIII.

DRYOBIUS ROBORIS. (Page 71.)

Fig. 1.—Apterous oviparous female. *b* represents the egg which she has laid, which is not strictly ovate, but inflected at the side. Unlike that of *D. croaticus* the egg is smooth and shining.

Fig. 2.—The winged male. The larger wings and lighter body permits more activity than that shown by the female.

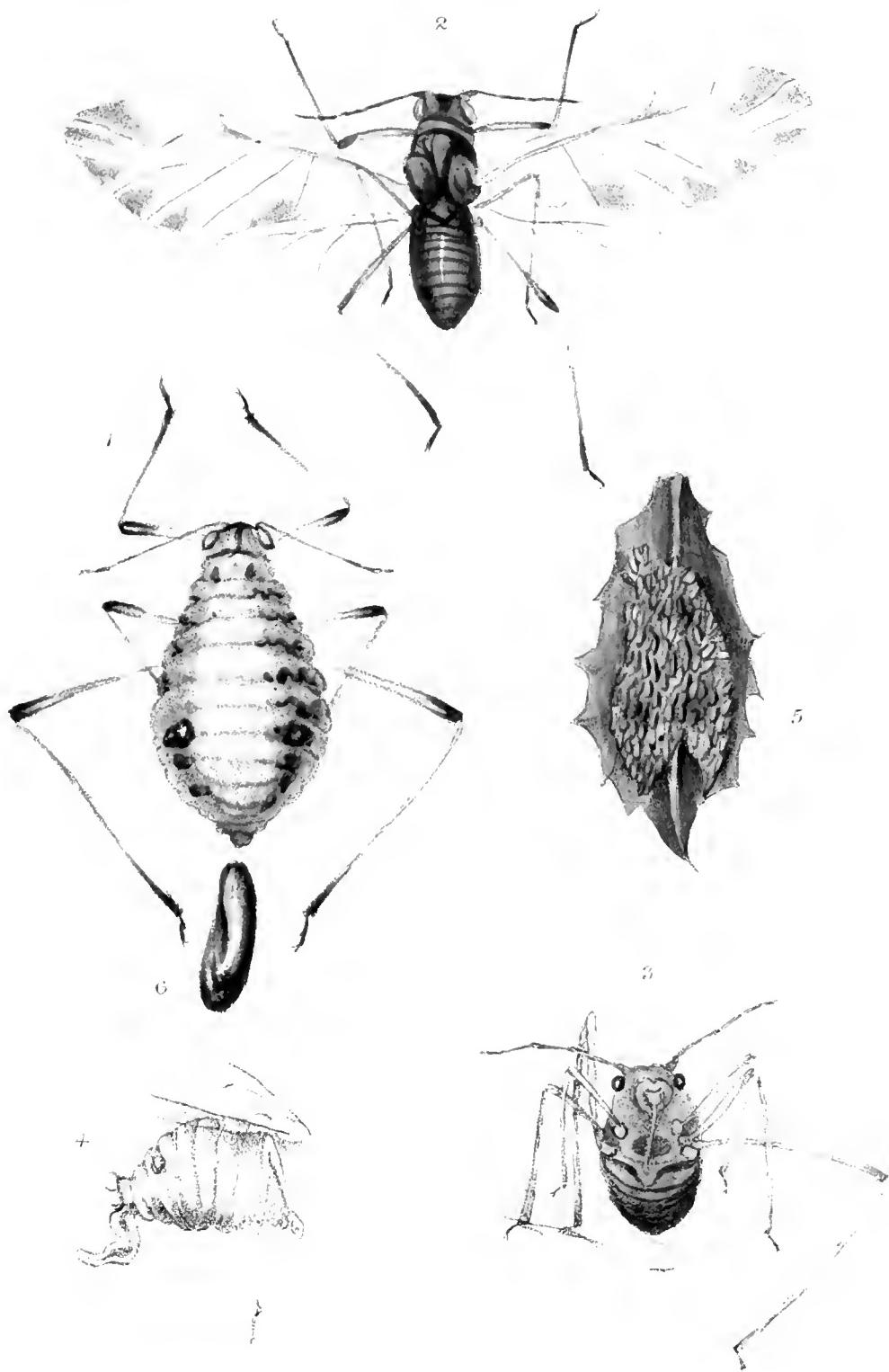
Fig. 3.—Front view of the apterous viviparous female, standing on a leaf, and showing the short proboscis and long hind leg.

Fig. 4.—Abdominal segments of fig. 2, showing the exerted and curved male organ.

Fig. 5.*—A leaf of *Quercus ilex* from Montpellier. The *upper* surface is occupied by a patch containing about two hundred eggs of *Dryobius Croaticus*, ranged with a certain regularity, with all their ends turned one way. This patch probably was the work of ten or more females, since several dead bodies of these were found adhering to the leaf. These eggs were all placed upon the upper surface of the leaf, and to protect them from rain they had for a covering an insoluble varnish. Unfortunately I failed in my efforts to hatch these eggs in the following spring.

* This figure 5 should have been drawn on Plate CIV.

PLATE CII



Dryobius roboris.

PLATE CIV.

DRYOBius CROATICUS. (Page 74.)

Fig. 1.—Apterous viviparous female. Attention may be drawn to the long legs and slender antennæ.

Fig. 2.—Winged female with its small wings and disproportionately large body.

Fig. 3.—Antenna and eye of the same.

Fig. 4.—Conical nectary rising from a dark areola.

Fig. 5.—A portion of one of the dark fascia of the wings, much enlarged. Two membranes are seen to overlap each other, but the hexagonal cells do not coincide. The pigment is confined to the peripheries of these cells.

Fig. 6.*—A portion of the bark of *Quercus robur* on which the female of *Dryobius roboris* has just laid three rows of eggs. These at first are white, but by exposure to the air they soon become brownish-black and velvet-like.

* This figure 6 should have been grouped with the last-described species.

PLATE CIV.



Drycoptes croaticus

PLATE CV.

SCHIZONEURA LANIGERA. (Page 89.)

Fig. 1.—Apterous viviparous female, with her young clothed with cotton-like fibres. This is the adult form of the young produced from the next insect.

Fig. 2.—The Queen Aphis or foundress of the colony with her young.

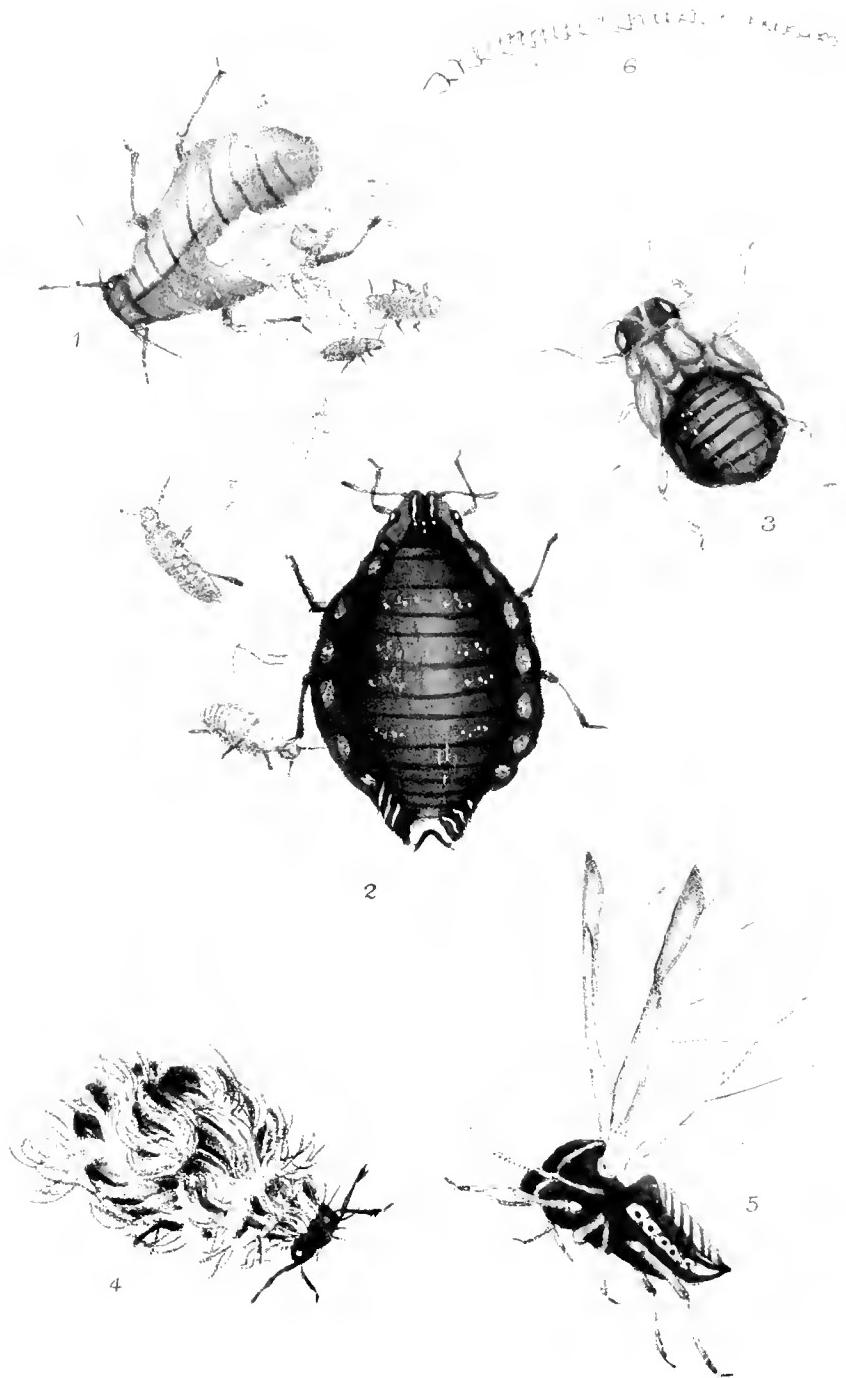
Fig. 3.—The pupa, which is almost naked of down.

Fig. 4.—Brown variety taken on the bark of the apple tree, December 5th, whilst the thermometer showed 20° Fahr. Snow on the ground.

Fig. 5.—Winged viviparous female.

Fig. 6.—Antenna of the same.

PLATE CV



Schizoneura lamigerus

PLATE CVI.

SCHIZONEURA LANIGERA—*continued.* (Page 89.)

Fig. 1.—Rostrated apterous male.

Fig. 2.—Non-rostrated oviparous female. These two figures are of relative size to the winged female which bore them (see fig. 5 on last plate).

Fig. 3.—Head, antennæ, and aborted mouth-parts of the oviparous female. No trace of a sucking organ can be seen. The antennæ also are degraded in form.

Fig. 4.—Young (male?) born also from fig. 5. The rostrum would seem to disappear at the subsequent moult. This sex therefore is finally blind as well as mouthless.

Fig. 5.—Sprig of apple bough, tufted with the “American blight,” drawn of natural size.

SCHIZONEURA FODIENS. (Page 94.)

Fig. 6.—Apterous viviparous female.

Fig. 7.—Pupa from the same. Both of these are subterranean forms.

Fig. 8.—Imago with her folded wings, drawn shortly after she has left the colony below ground.

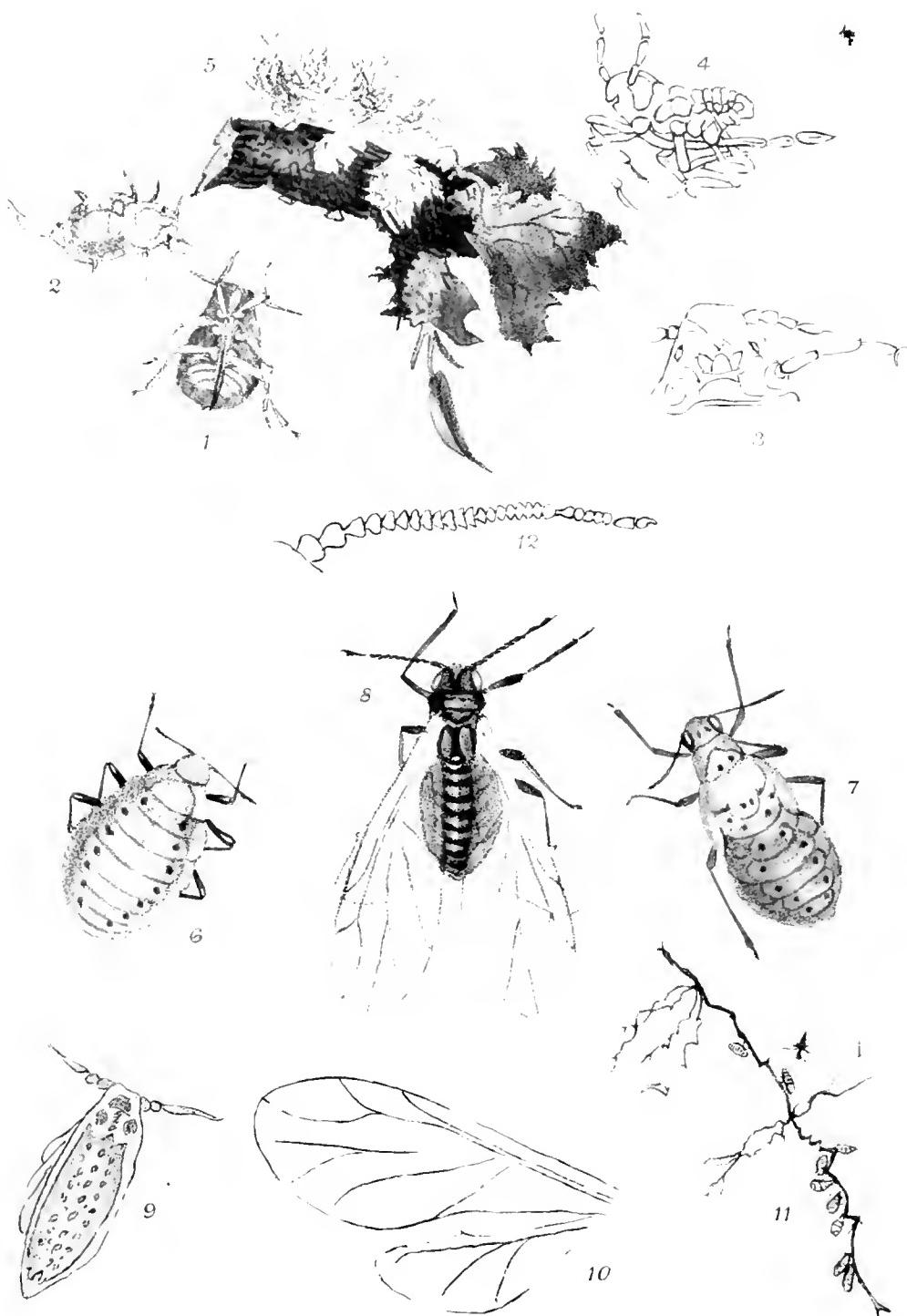
Fig. 9.—Young just born from the winged female. The legs are hardly yet disengaged.

Fig. 10.—Upper and lower wings of imago.

Fig. 11.—Portion of the root of Ribes (black currant) infested by this Aphis. Nat. size.

Fig. 12.—Antenna of the same.

PLATE VI



Schizoneura lanigera. Fig. 1-5.
fodiens. Fig. 6-12.



PLATE CVII.

SCHIZONEURA FULIGINOSA. (Page 96.)

Fig. 1.—Pupa covered by its tomentose coat. It is rather greyer in nature than is here represented by the figure.

Fig. 2.—Winged female of the same.

Fig. 3.—Apterous male, drawn under the same magnifying power as the former insects. Captured early in November.

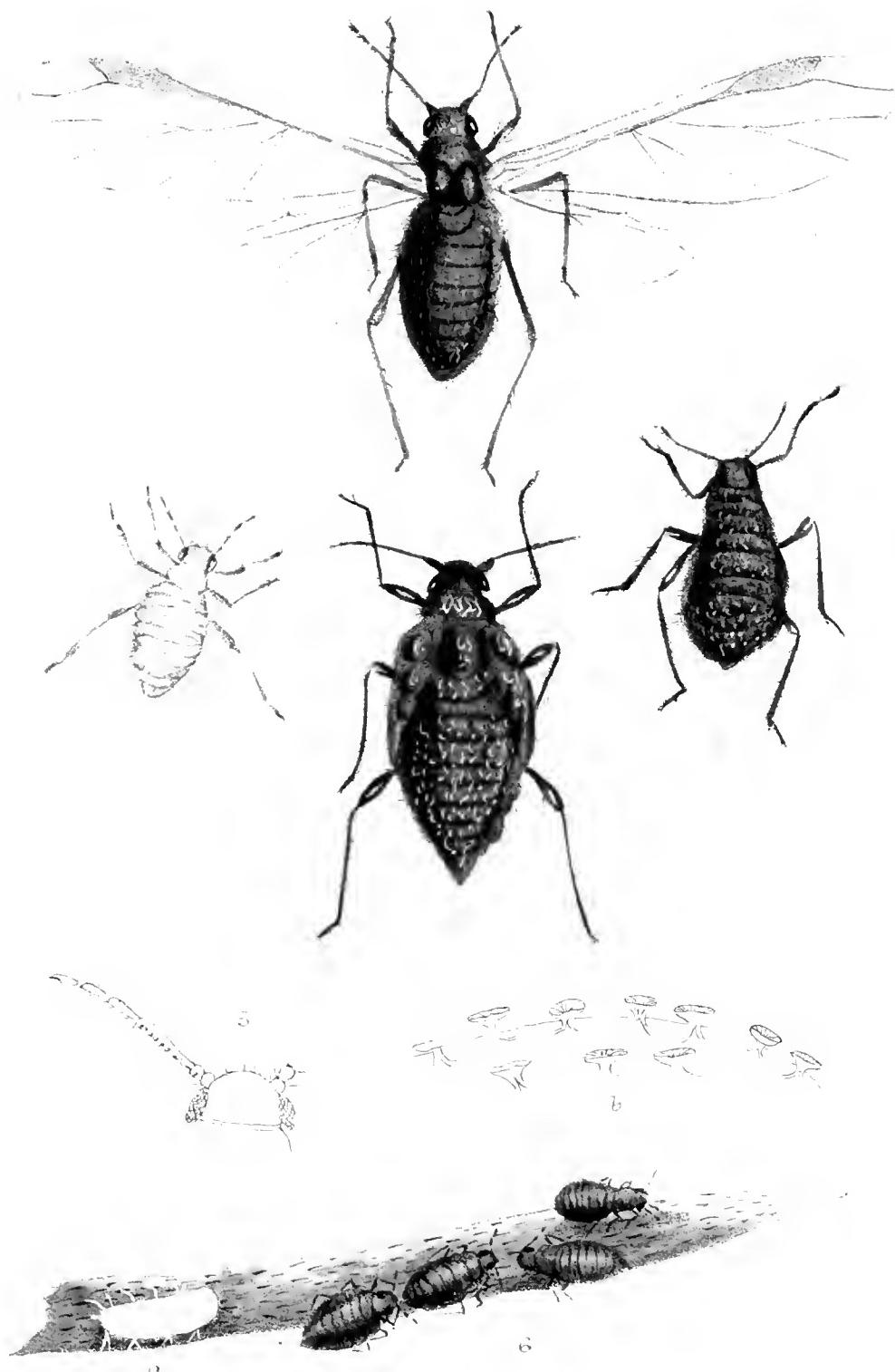
Fig. 4.—Female taken in company with the last, perhaps the perfect-sexed female. Not quite so small as the male.

Fig. 5.—Head and antenna of the imago.

Fig. 6.—Part of a leaf of *Pinus austriaca*, with young Aphides feeding thereon. Usually they range themselves in a long file, with their heads placed in one direction. *a.* An ovum of one of the Syrphidæ secured to the pinna by several silken mooring threads. *b* represents the outer covering of this egg, much magnified, in which the pores of the membrane are seen to be continued and expanded into corrugated trumpet-like mouths. The whole shell is covered by these stomata, and they form an interesting object for the microscope. The aeration of the ovum, doubtless, is effected through these openings. I have not been able to prove whether they close hygrometrically or not. The egg becomes beautifully transparent by soaking in weak glycerine, and it then shows a footless grub within.

Scæva pyrastris is said to live ten or twelve days in the larval condition, and about fourteen as a quiescent pupa. The existence of the imago may be prolonged to six weeks. These ova are not uncommon in the vicinity of such Aphides, which constitute the food of the voracious maggots that hatch out of them.

PLATE CVII.



Schizoneura fuliginosa.

PLATE CVIII.

SCHIZONEURA ULMI. (Page 97.)

Fig. 1.—Queen Aphis. The produce from an egg.

Fig. 2.—Head and antenna of the same. *a.* Coxæ.

b. Small rudimentary eye, composed of eight or ten facets only. The antenna has only four joints.

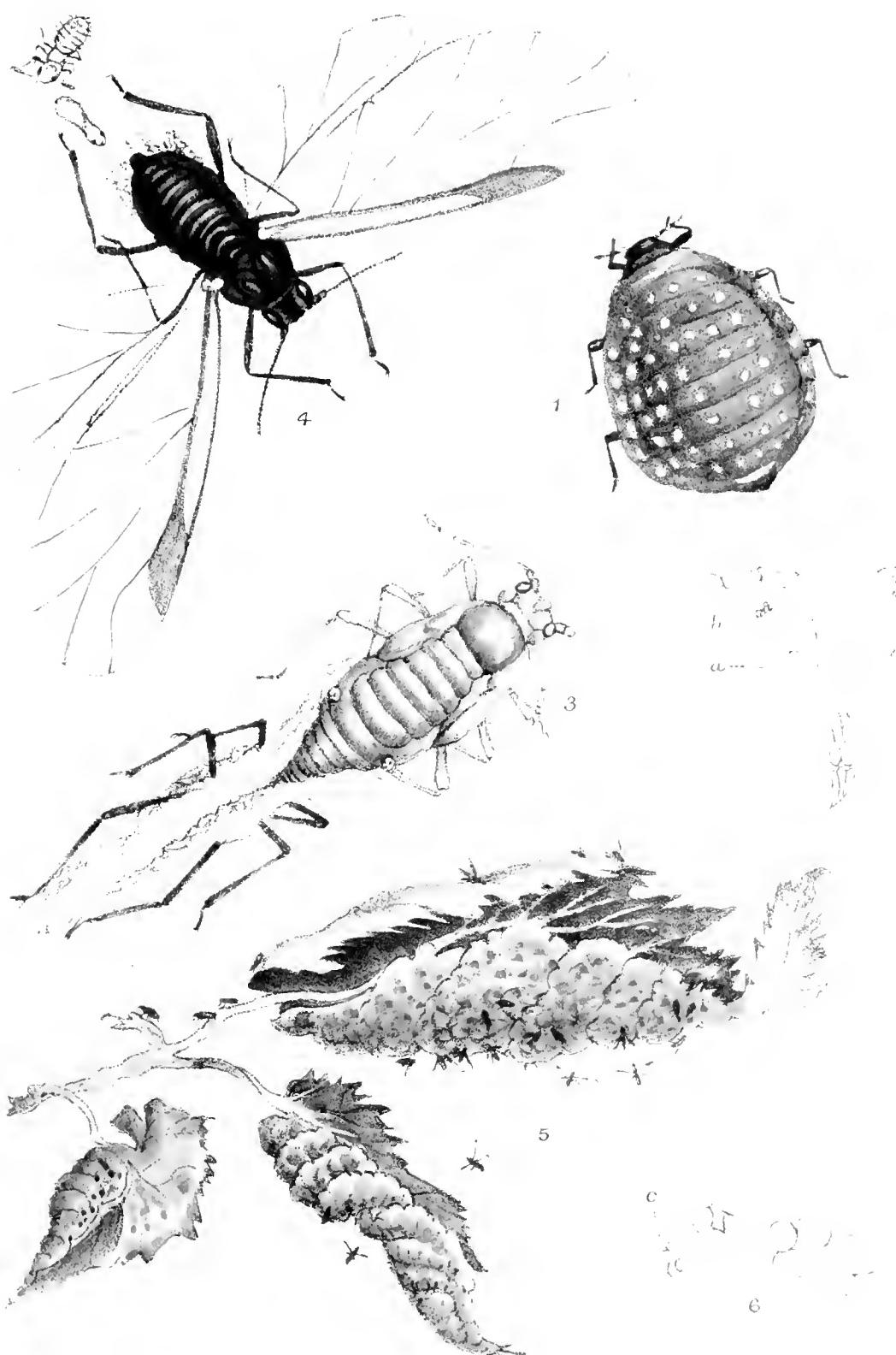
Fig. 3.—The imago extricating itself from its pupal integuments, and shedding all its woolly coat at the same time. The limbs and wing-cases at first are very transparent.

Fig. 4.—Mature imago with young. The last-born foetus has not disengaged itself from its investing membranes.

Fig. 5.—Leaves of the elm, rolled and blistered by the Aphides, which nest within. The winged insects are represented of their natural size.

Fig. 6.—Globules of (fæcal ?) matter interspersed with mealy powder, being part of the contents of the above rolled leaves. *c.* Membranous fragments which remain after these globules have burst.

PLATE CVIII.



Schinzoneura ulmi

PLATE CIX.*

SCHIZONEURA ULCI (*continued*). (Page 97.)

Fig. 1.—Young *Aphis* born from the Queen *Aphis*.

Fig. 2.—The same matured.

Fig. 3.—Antenna of the apterous viviparous female (fig. 2).

Fig. 4.—Antenna of the winged viviparous female.

SCHIZONEURA LANUGINOSA. (P. 104.)

Fig. 5.—Part of the third, and the whole of the fourth, fifth, and sixth antennal joints of the imago of the first alate generation.

Fig. 6.—The apterous viviparous female.

Fig. 7.—The pupa.

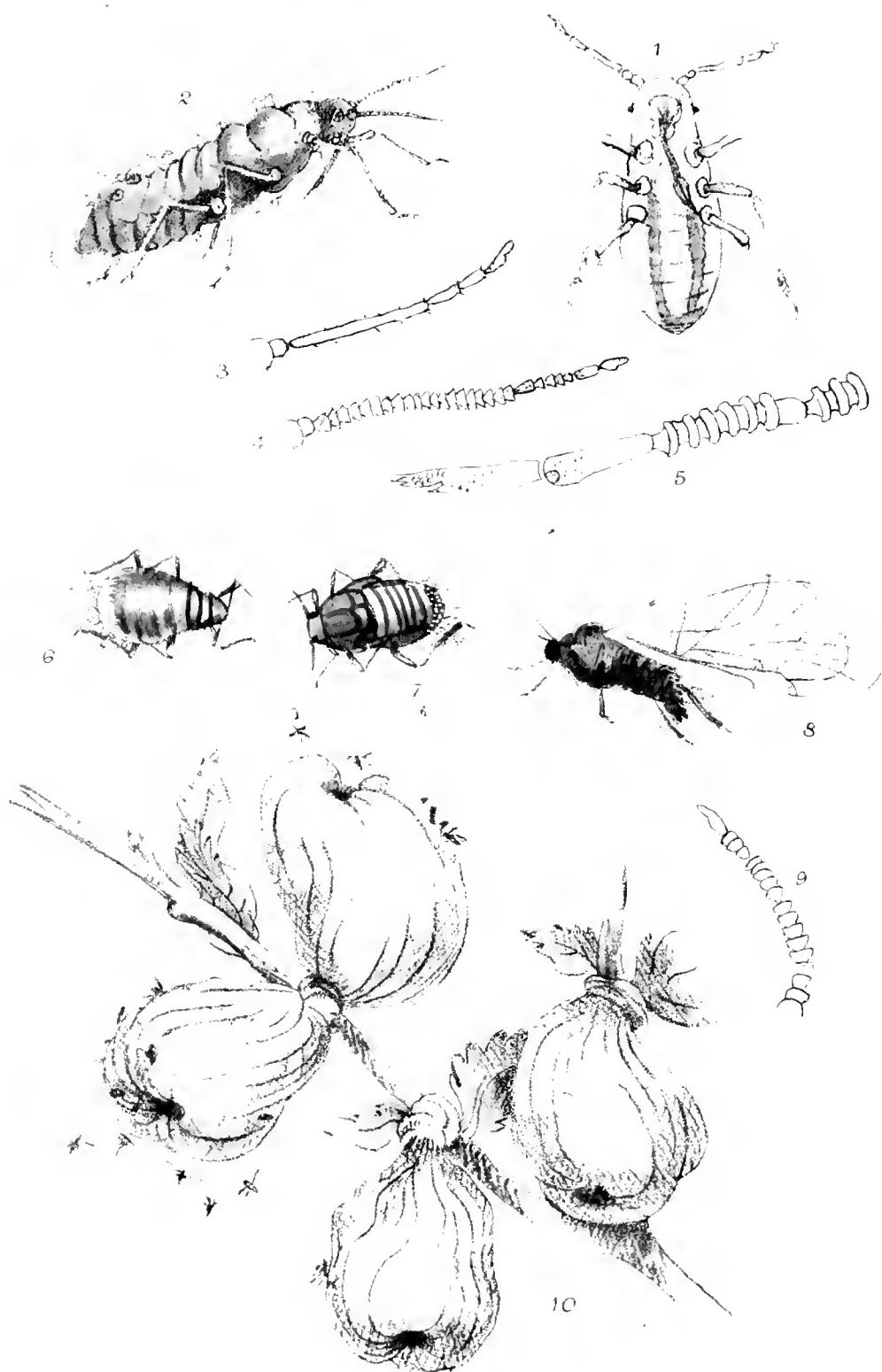
Fig. 8.—The imago seen in profile, which has placed its wings pentwise whilst at rest. The small size of these insects is due to their being examples of the last alate generation.

Fig. 9.—Antenna of fig. 8, showing a modification of fig. 5, the second alate generation.

Fig. 10.—A twig of elm (*Ulmus campestris*), one third of the natural size, with purses constructed by *Schizoneura lanuginosa*, gathered at Cambridge, August 7th, 1871. The galls were full of pupæ and winged insects ready to emigrate.

* The lettering on this place is an error. For figs. 1—5 read 1—4, and for figs. 6—10 read 5—10.

PLATE CIX.



Schizoneura ulmi, Fig. 1-5

n

Tanypus ulmi, Fig. 6-10

PLATE CX.

SCHIZONEURA CORNI. (Page 107.)

Fig. 1.—Winged viviparous female.

Fig. 2.—Apterous male.

Fig. 3.—Oviparous female which is eyeless.

Fig. 4.—Antenna of the imago plentifully supplied with tubercles.

PEMPHIGUS FUSCIFRONS. (Page 113.)

Fig. 5.—Apterous viviparous female.

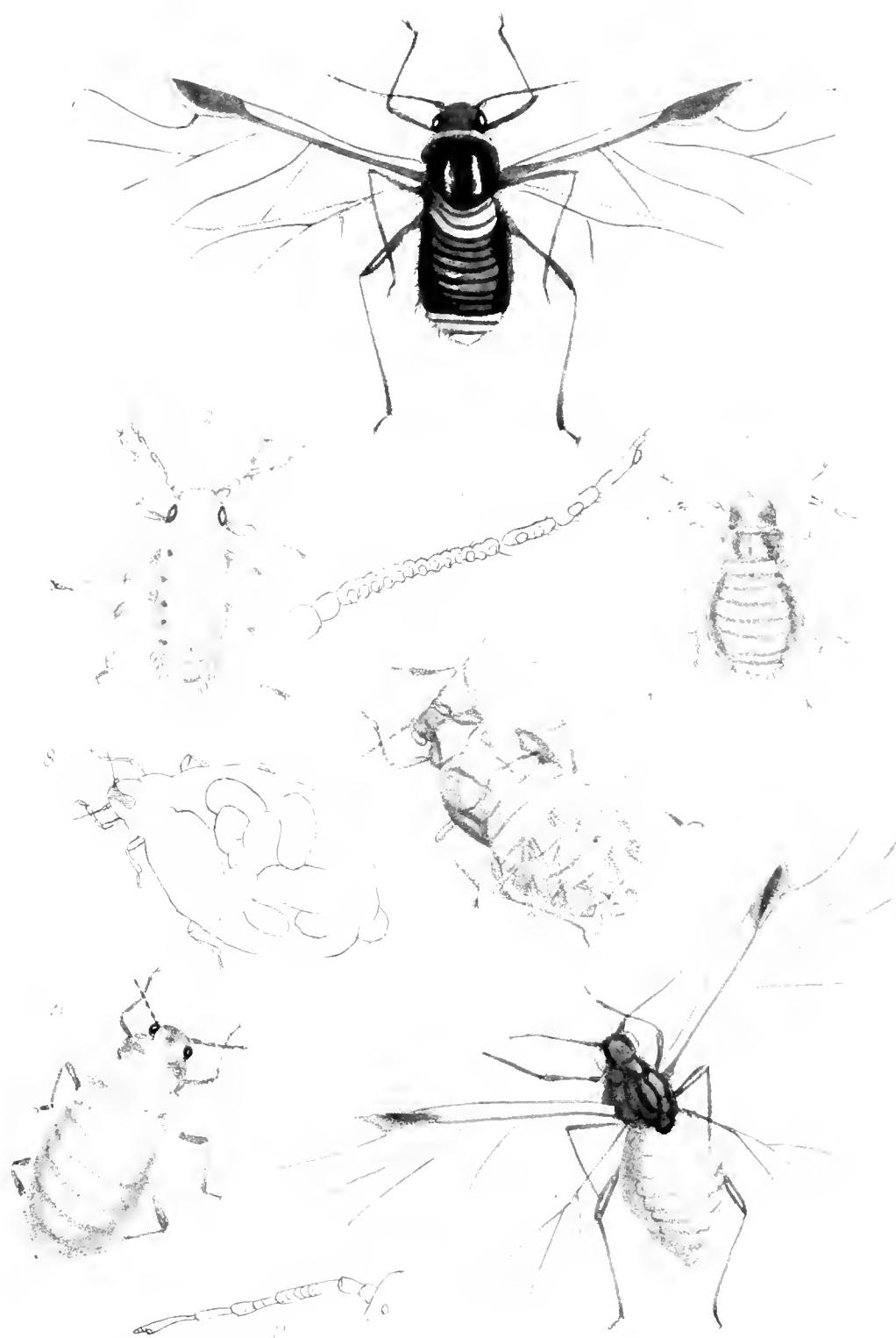
Fig. 6.—Pupa. The cotton-like tufts occur in isolated bunches.

Fig. 7.—The imago. Attention may be called to the veining of the under wings.

Fig. 8.—The oviparous female crowded with ova.

Fig. 9.—Antenna of the imago.

PLATE CX



Schizoneura corni Fig. 1-4
Penophagus fusciventris Fig. 5-6

PLATE CXI.

PEMPHIGUS BURSARIUS. (Page 117.)

Fig. 1.—Queen *Aphis*—apterous female.

Fig. 2.—Pupa with circular white mealy patches, like the above queen.

Fig. 3.—Imago, with young, which last have by some been mistaken for ova. The angular veining of the hind wing differs from the foregoing species.

Fig. 4.—Leaf of poplar, the foot-stalk of which has been punctured by the Queen *Aphis*. Two purses are here formed with corrugated openings, through which the winged females escape. This form of gall is thought by Lichtenstein to be the work of a species which he proposes to call *P. pyriformis*. He considers the round gall (Pl. CXIII, fig. 7) to be the work of *Pemphigus bursarius*.

Fig. 5.—Section of a pyriform gall, natural size, showing within the cavity the Aphides covered with mealy dust.

Fig. 6.—Antenna of fig. 1.

Fig. 7.—Antenna of imago (fig. 3).

PEMPHIGUS SPIROTHECÆ. (Page 122.)

Fig. 8.—Apterous viviparous female, covered with white down.

Fig. 9.—Bottle-like gall, found on the stem of the black poplar (*Populus nigra*). Probably an abnormal form, and the work of *Pemphigus spirothecæ*. The normal spiral “galls” are represented in Pl. CXII, figs. 1—3.

PLATE CXT



Pemphigus burckii. Fig. 1-7
" " spirothecan Fig. 8-9

PLATE CXII.

PEMPHIGUS SPIROTHECAE (*continued*). (Page 122.)

Fig. 1.—Leaf and foot-stalk of *Populus nigra*. A winding cavity has been formed, which is more or less blistered by the sucking of the Aphides.

Fig. 2.—The same construction viewed sideways.
s. The opening.

Fig. 3.—Another example, better showing the spiral contortion of the stem. By a gentle strain the foot-stalk stretches and opens like a helix. s. The opening.

Fig. 4.—The oviparous female with her single included egg.

Fig. 5.—The non-rostrated apterous male. p. The penis.

Fig. 6.—The head and simple antenna of the oviparous female.

PEMPHIGUS LACTUCARIUS. (Page 124.)

Fig. 7.—The nearly naked viviparous female (queen?).

Fig. 8.—The same in a more adult form, with longcurls of cottony fibre.

Fig. 9.—Head, antennæ, rostrum, and eyes of fig. 8.

Fig. 10.—Antenna of the adult form.

Fig. 11.—Vermiform larva, possibly representing an ancestral type. The point of the rostrum may be seen protruding on one side.

Fig. 12.—“Degraded” head and antennæ of fig. 11, with almost obsolete eyes.

Fig. 13.—Section made through a clod of earth, and thus exposing a cavity tenanted by *P. lactucarius*. Natural size.

PLATE CXII.



Pemphigus spirothecæ
„ lactucarius Fig. 1-6
Fig. 7-13



PLATE CXIII.

PEMPHIGUS PALLIDUS. (Page 127.)

Fig. 1.—Queen *Aphis* or foundress.

Fig. 2.—Pupa.

Fig. 3.—Imago. The stigmata are pale emerald green, with a dark internal spot.

Fig. 4.—Antenna of the Queen *Aphis* with its isolated tubercles.

Fig. 5.—Gall formed on the midrib of *ulmus*.

PEMPHIGUS BURSARIUS. (Page 117.)

See also Plate CXI, figs. 1—7.

Fig. 6.—Queen *Aphis*, showing the small legs and antennæ of the insect.

Fig. 7.—Part of a small branch of poplar, on the woody portion of which a rugose gall has been constructed, with two openings, one at the top and the other at the side *o o*. This and some other pseudo galls were sent to me by M. Lichtenstein with the remark that he considered them to be the work of *P. bursarius*, whilst the pyriform galls he considered to belong to a different species. In this uncertainty, I prefer simply to call attention to their different forms, and not to name the insects on my insufficient knowledge. The imagos which issue from these galls are very like the British insects, but they show some modification in the form of their antennal joints.

Fig 8.—Antennal joint of imago from gall (fig. 7).

PLATE CXIII.



Pemphigus pallidus. Fig. 1 - 5.
" bursarius. Fig. 6 - 8

PLATE CXIV.

PEMPHIGUS FILAGINIS. (Page 128.)

Fig. 1.—Winged viviparous female with the body sparsely dotted with down.

Fig. 2.—Semi-transparent oviparous female.

Fig. 3.—Head and appendages of the last insect.

d. The processes representing the mouth parts. *e.* The rudimentary eye.

Fig. 4.—Antenna of the imago.

TETRANEURA ULMI. (Page 131.)

Fig. 5.—Queen *Aphis*, just turned out of the gall (fig. 12).

Fig. 6.—Second brood of the winged females. She has just borne an oviparous female (fig. *e*), which is drawn of the relative size.

Fig. 7.—Antenna of imago.

Fig. 8.—Non-rostrated oviparous female, much magnified, with her gigantic egg. *d.* Buccal parts.

Fig. 9.—Antenna of oviparous female.

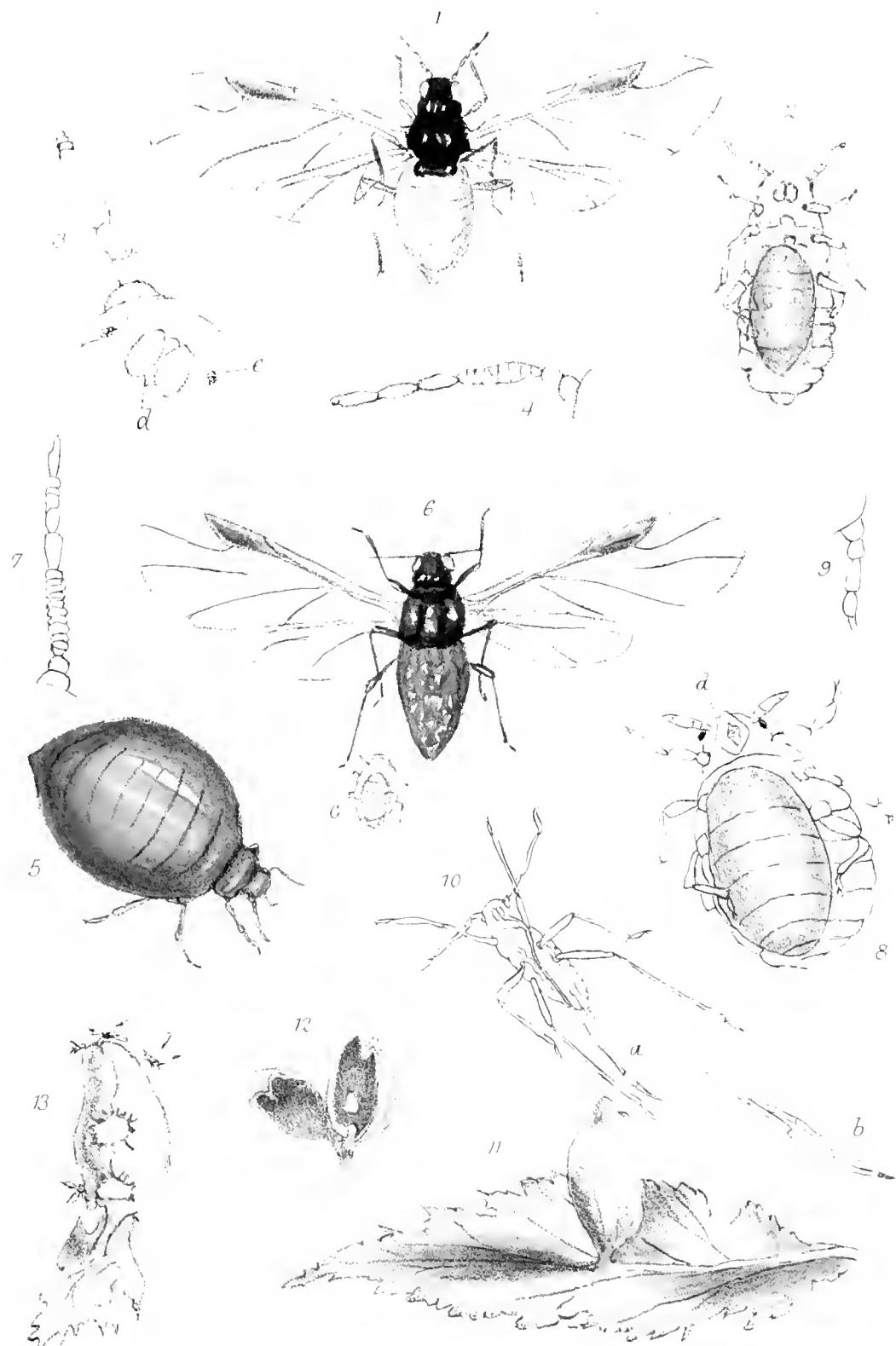
Fig. 10.—Young born together with about thirty others from the spring brood of a winged female. *a.* The rostrum, *b.* the last joint.

Fig. 11.—Upright pedunculated gall, natural size, springing from the midrib of *Ulmus tuberosa*.

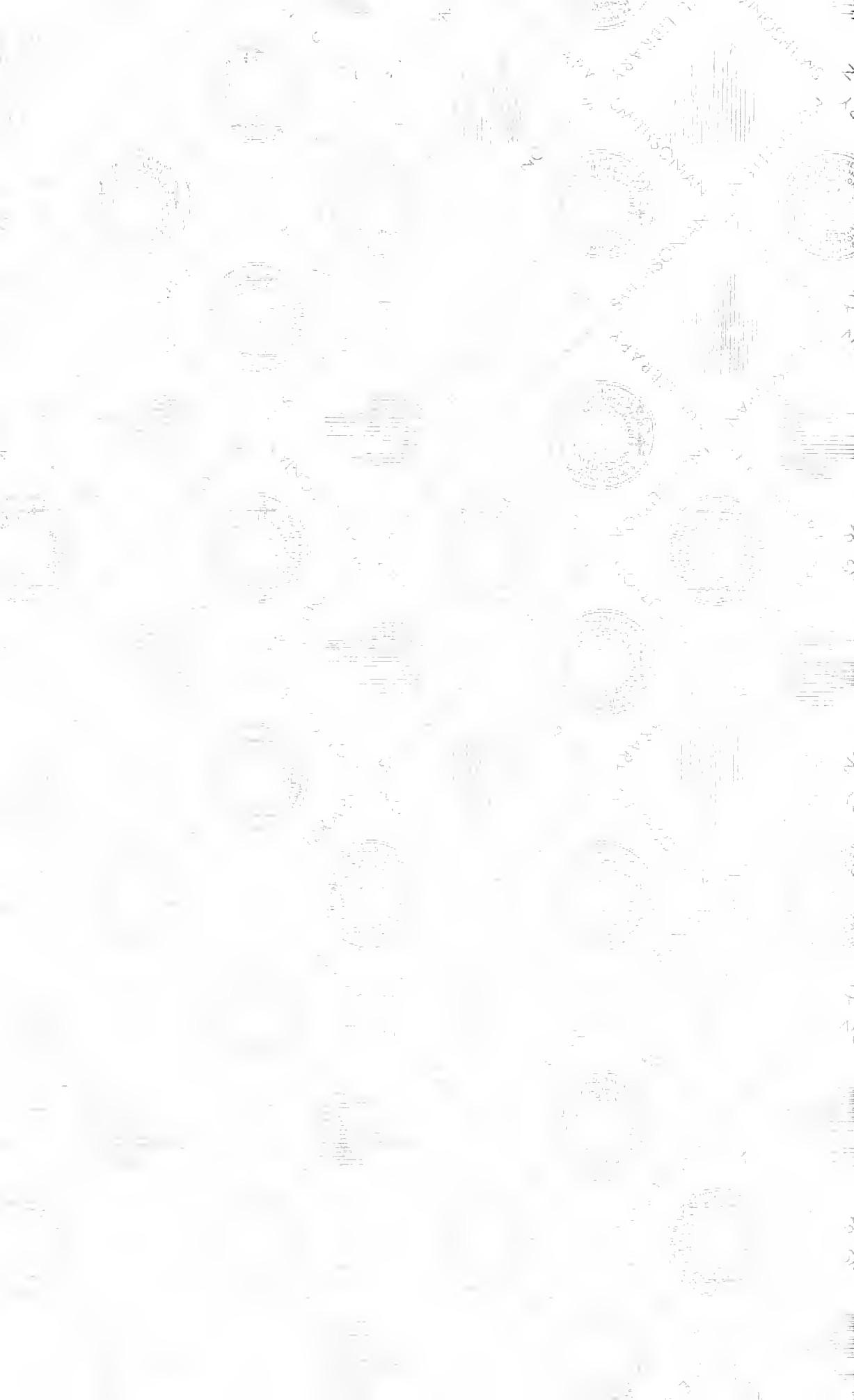
Fig. 12.—A gall slit in half, showing the Queen *Aphis* within.

Fig. 13.—Another gall springing from the membranous portion of a leaf. The gall is empty, but several winged females are flying above it.

PLATE CXIV.



Pemphigus filaginis. Fig. 1 — 4.
Tetraneura ulmi. Fig. 5 — 13.





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